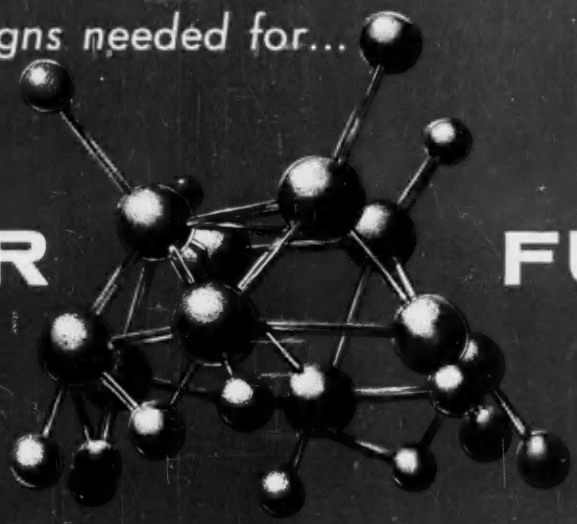
SEPTEMBER 9, 1957 PRICE 50 CENTS

R&D Research Development Edition

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

New engine designs needed for...



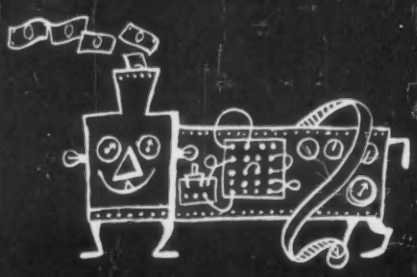
SUPER FUELS

see page 25

Is your new product

DOOMED?

see page 54



Are computers oversold? see page 40

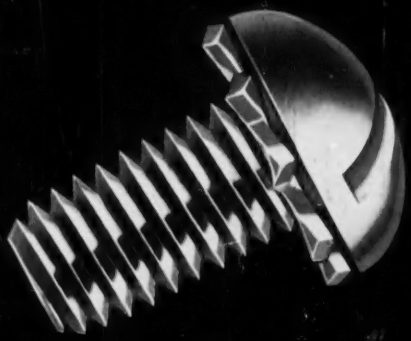
E B POWER GS D I
UNIVERSITY MICROFILMS IN
313 N 1 ST
ANN ARBOR MICH

Pre-assembled

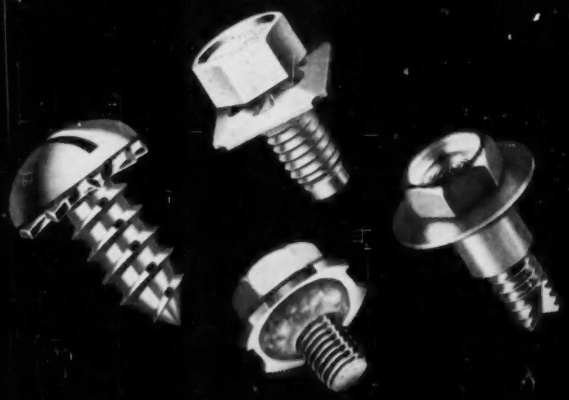
to cut your

Costs

...by eliminating handling of multiple parts



SEMS-BY-SHAKEPROOF
Pre-assembled Screw
and Shakeproof® Lock Washer



Even greater cost-savings are possible with Sems-by-Shakeproof through variations in threads, points, heads, and washers, or with the addition of sealing compound or special sleeves.

• You handle one unit instead of two or more with Sems-by-Shakeproof • Every lock washer is factory-matched • Lost and forgotten washers eliminated • Available in variety of screw and lock washer combinations, multiple-piece assemblies and with mastic sealants.

Send for Sems-by-Shakeproof sample kit today

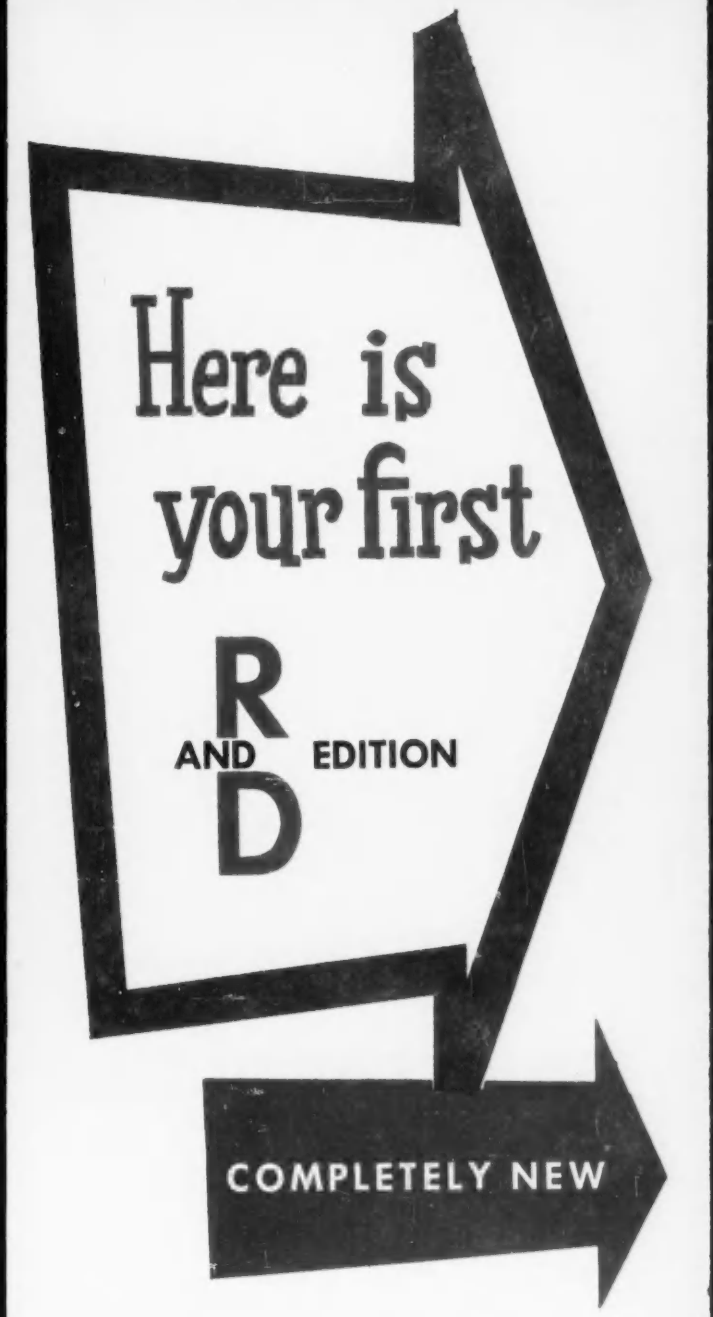
SHAKEPROOF

"FASTENING HEADQUARTERS"®

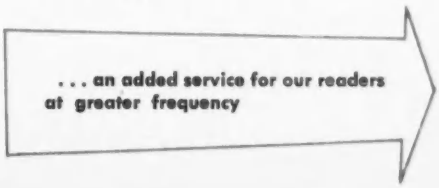
DIVISION OF ILLINOIS TOOL WORKS

St. Charles Road, Elgin, Illinois • Offices In Principal Cities
In Canada: SHAKEPROOF-FASTEX, Division of Canada Illinois Tools, Ltd., Toronto, Ontario

itw



. . . a fortnightly fast-reading analysis and report of the rapidly growing field of product research and development . . . alternating with the Design Edition, containing the familiar **Product Engineering** content, but on a fortnightly basis. . . . concise interpretation of engineering developments, new processes, new materials, new design thinking affecting product planning



coming next week . . .

the DESIGN edition

. . . the familiar **Product Engineering,** in a new easier-to-handle form, with all the familiar engineering content.

Featuring next week:

- **Inside the Edsel . . .**
  Engineering details of motordom's newest car, plus a cover picture of the chassis.

- **Hard *and* Tough Rubber . . .**
  First details on designing with urethane rubber, hard enough, for example, to make lawnmower blades that will not chip.

- **Models . . .**
  A 4-color Special Report picturing engineering models of many types, and showing how they can help you.

- **Shock Loading of Bearings**
  A roundup of methods to reduce the effects of shock on all types of ball bearings.

Research and Development Edition

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

September 9, 1957 Vol. 28, No. 9

FEATURED:

DEPARTMENTS

SIDELIGHTS 2
HORIZONS 23
SIGNIFICANT PARTS 58
NEW LITERATURE 67
MEETINGS 69
PUBLISHER'S POSTSCRIPT 72
FYI PERSONAL 73
WHY NOT R & D? 74

SUPER FUELS. They're posing problems in aircraft-engine design 25

ARE COMPUTERS OVERSOLD? Consultants are having second thoughts about economy and value considerations 40

TRENDS IN APPEARANCE DESIGN. Integrated pedestal replaces classic tree-shape of dental instrument unit 42

HOW PRODUCT PLANNERS WORK IN CANADA. Organization of a 27-yr old development department 46

KEEPING ENGINEERS HAPPY. The supervisor's responsibility to his men requires understanding and tact 49

POINTS OF VIEW. What factors enter into your decision to redesign an existing product rather than design a new one? 52

IS YOUR NEW PRODUCT DOOMED? 9 guideposts to successful product planning 54

FIELDS OF INTEREST:

MATERIALS:

New steels pop up overseas 13
Japan uses plastics in lenses and rocket engines 15
Titanium clads low-cost steels 16
New uses for butyl rubber 8
Zinc layer between steel and copper-nickel-chrome plating prevents rust 19
Nickel-alloy cladding gives stainless characteristics to mild steel 19

PROCESSES:

Pelletized electrodes simplify production of high-purity Ti ingot 19
Molybdenum seamless tubing by cold extrusion 29
Color specification made easier 5

ELECTRICAL:

New clothes drier designed to prevent radio interference 13
Solion, spacistor and cryotron—three new devices to remember 16

DESIGN:

Reading machine scans any document at 300 characters per sec 15
Design for throw-away 8
Aluminum vs. steel subway cars—a Canadian problem 28
If starting is difficult, look at the engine, not the starter 6
Armor-piercing projectile has glued-on windshield 28

TEST:

How does fuel burn in gravity-free outer space? 16
Solar furnace gives clean heat for testing 8

GOVERNMENT:

Designs accepted or rejected faster with new Army setup 11
Higher zinc tariffs turned down by Congress 31

PERSONNEL:

Curtiss-Wright, Daimler-Benz deal still uncertain 31
The engineering shortage—an economist's view 33
Human barrier a major design problem for Air Force 11

Product Engineering ..... SIDELIGHTS

Research and Development edition

ALBERT HAUPTLI *publisher*

ELMER J TANGERMAN *editor*
ROBERT W CARSON *managing editor*

PAUL N ANDERSON *associate editor*
ROBERT E ABBOTT *associate editor*
JAMES R McDERMOTT *associate editor*
JOHN KOLB *associate editor*
NICHOLAS CHIRONIS *associate editor*
RICHARD M KOFF *associate editor*
HENRY E COOK, JR *associate editor*
FORD R PARK *associate editor*
ROBERT S PRENTISS *associate editor*
ANNESTA R GARDNER *associate editor*
WILLIAM GILMAN *associate editor*

JOSEPH J KELLEHER *assistant editor*
BENEDICT A LEERBURGER, JR *assistant editor*
DOUGLAS C GREENWOOD *asistant editor*
FRANKLIN D YEAPLE *assistant editor*
PHYLLIS B SWEED *assistant editor*
DONALD G PICNICH *assistant editor*
DORA K MERRIS *assistant editor*
HERBERT KEE *assistant editor*
ALAN CORNERETTO *assistant editor*

FELIX GIORDANO *Detroit*
SETH PAYNE *Washington*
JACK MEYER *Los Angeles*

RICHARD E ROOMAN *art director*
E. GORDON LOADER *assistant*

NORMA J VAN NESS *production supervisor*
LILLIAN M WITHAM *assistant*
NANCY OLIVE *assistant*

JOSEPH KERR *consulting editor*
ROBERT E BRUCKNER *consulting editor*

DEXTER KEEZER *director economics dept*
GEORGE B BRYANT, JR *Washington*
RICHARD A LAWRENCE *European correspondent*
DONALD MacDONALD *Detroit*
WILLIAM G MELDRUM *Cleveland*
MARGARET RALSTON *San Francisco*
JOHN SHINN *Los Angeles*
MICHAEL J MURPHY *Los Angeles*
CHARLES T DIXON, JR *Atlanta*
KEMP ANDERSON, JR *Dallas*
JOHN WILHELM *editor, world news*
JOHN TUNSTALL *London*
ROBERT E FARRELL *Paris*
PETER WEAVER *Rio de Janeiro*
SILKE BRUECKLER *Bonn*
DAN KURZMAN *Tokyo*
JOHN H KEARNEY *Mexico City*

STANLEY J ALLING *associate publisher*
PHILIP G WEATHERBY *advertising sales manager*
P F PRITCHARD *manager, market research*
ROBERT C MATTOON *circulation manager*
C C KANE *reader service manager*
RUSSELL T DOUGLAS *business manager*

● **The Army will spend** $1.7 million just to see if they can get jeeps to fly. This may seem like a lot, yet private companies invest as much or more in new products that have much less chance of getting off the ground (see page 54). In a recent survey, management impatience was found to be the major cause of failure. Who didn't know? Development engineers have been fighting for more time since the invention of the wheel.

● **A wide-eyed staff** editor came tearing into the office the other day shouting, "Gadgets, gadgets . . . that's all they invent nowadays. Potato peelers and can openers . . . is that the best they can do? What this world needs is genius! Where are anti-gravity, radio power, force fields?" We suggested that maybe he had been reading too much science fiction but he insisted that with only a little development work some really wonderful devices could be made right now. We challenged . . . and you see the results on page 74.

● **Motivation Research** is an attempt to dig into the subconscious to find out what we *really* want. Analysts insist that we often prefer things for reasons very different from what we believe. Okay—we'll buy that, and do all we can to help management, make engineers happy by these principles (see page 49). But when some smart analyst tries to sell an engineer a teardrop jig borer . . . look out. He's in for an awful shock.

● **When announcing the "spacistor"**, a new subminiature transistor, Raytheon representatives calculated that it was one pinhead wide by four pinheads long. Not to be outdone we set our best computer the task of calculating our expansion in staff and space in this new system of units. For your information our office has been increased in length by some 12,500 pinheads, 6 new cubicles (1600 x 1920 ph) and 10 new desks (528 x 960 ph) were added. "Staff increases are less impressive, however," our computer reported. "Only 21 new pinheads were hired."

ABP SEPTEMBER 9, 1957 **Product Engineering** Vol. 28, No. 9 ABC

A McGRAW-HILL PUBLICATION

PRODUCT ENGINEERING is published weekly, with an additional Design Digest Issue in Mid-October, by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGraw-Hill Building, 330 W. 42nd St., New York 36, N. Y. See panel below for directions regarding subscriptions or change in address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice-President; L. Keith Goodrich, Vice-President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice-President and Director of Advertising Sales; A. R. Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and consultants engaged in the design of machinery and other engineered products. **Position and company connection must be indicated on subscription orders. Send to address shown in box below.**

United States subscription rate for individuals in the field of the publication, $5.00 per year, single copies, fifty cents; foreign $25 per year, payable in advance. Second-class mail privileges authorized at Albany, N. Y., U.S.A.

© Copyrighted 1957 McGraw-Hill Publishing Company, Inc., all rights reserved.

PRODUCT ENGINEERING articles are indexed in both the **Industrial Arts Index** and the **Engineering Index.** PRODUCT ENGINEERING publishes its own annual index including the Design Digest Issue in December issue each year. Copies are obtainable on request to the Editor.

SUBSCRIPTIONS. Send subscription correspondence and change of address to Subscription Manager, PRODUCT ENGINEERING, 330 W. 42nd St., New York 36, N. Y. Subscribers should notify Subscription Manager promptly of any change of address giving old as well as new address, and including postal zone number, if any. If possible, enclose an address label from a recent issue of the magazine. Please allow one month for change to become effective.

Postmaster: Please send form 3579 to PRODUCT ENGINEERING, 330 W. 42nd St., New York 36.

Positive Load Transfer

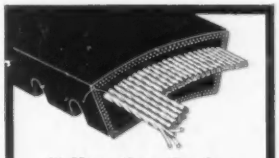
The special "floating gum" insulating section transfers the load to the carrying cords—prevents chafing.

True Dimensional Stability

It's muscled by the exclusive Triple-Tempered (3-T) Cord to give you true dimensional stability in storage and in service.

Highest Transverse Rigidity

The special compression section of fiber-reinforced synthetic rubber strongly resists dishing under side pressure—protects from undue fatigue.



Uniform Cross Section

Precision molding assures an always uniform cross section throughout the length of each belt.

NOW— AN INVARIABLE CURE

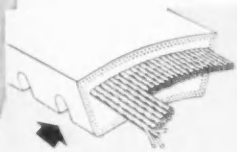
to variable speed drive headaches

Assured Balance of Yield

The special "cool-running" tension section makes the top of the belt yield in exactly the opposite direction as the bottom—equalizes pull on either side.

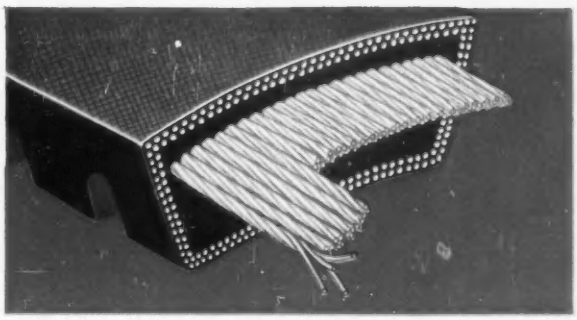
Excellent Gripping Ability

The specially compounded, highly abrasion-resistant cover assures a strong, uniform grip on both faces of the sheave.



Controlled Flexibility

Completely uniform notching gives you the flexibility to bend over small pulleys—without sacrifice of cross-rigidity or strength.

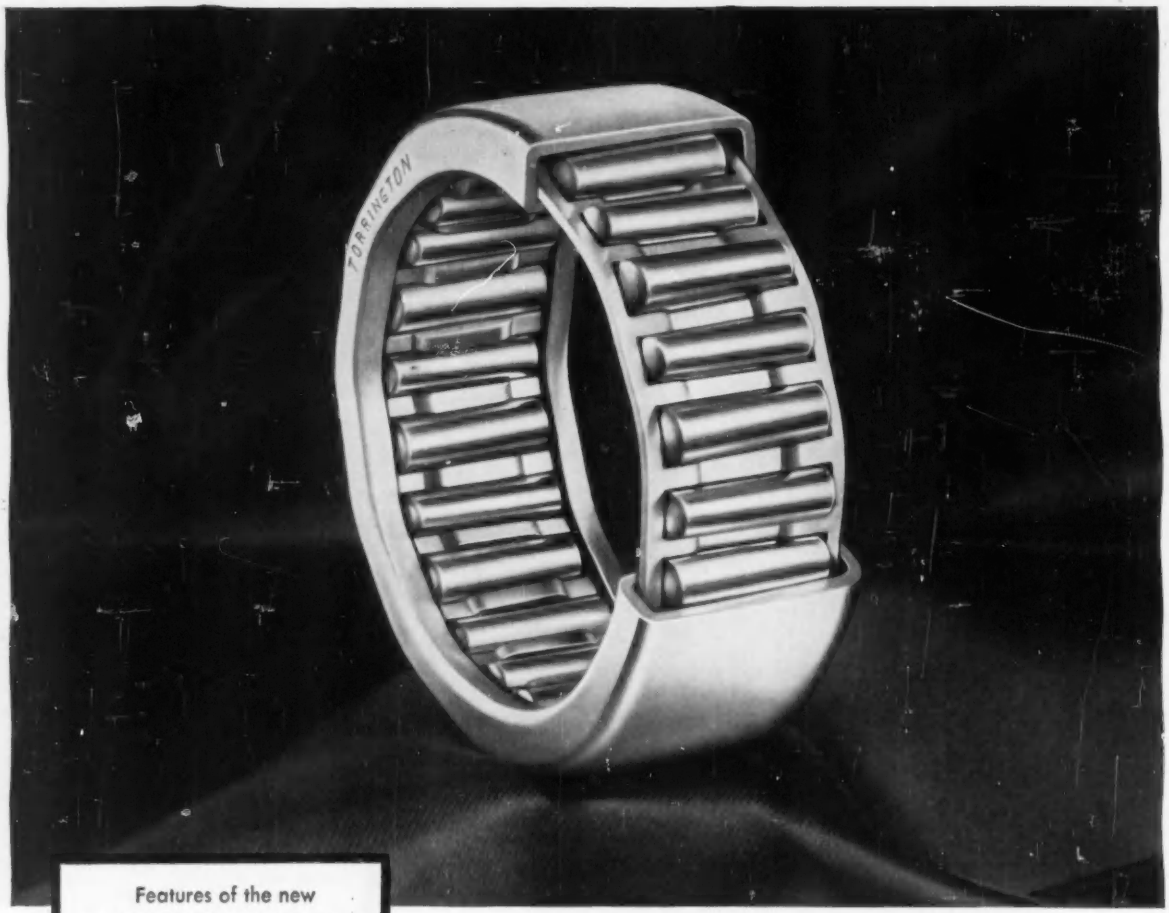


HERE, at last, is a belt with all the answers to one of your toughest of belting problems: harnessing variable speed drives. It's the great new Goodyear Variable Speed Belt—developed through years of research and testing.

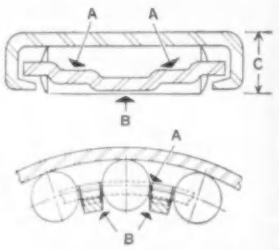
And it brings you all the Goodyear *extra-quality* features that assure the maximum, trouble-free horsepower hours at minimum cost. For more details, contact the G.T.M. – Goodyear Technical Man – through your Goodyear Distributor. Or write Goodyear, Industrial Products Division, Akron 16, Ohio.

VARIABLE SPEED BELTS by **GOODYEAR**

THE GREATEST NAME IN RUBBER



Features of the new
TORRINGTON DRAWN CUP ROLLER BEARING



- rollers end-guided at pitch line (A)
- shaft-riding retainer (B) designed to permit lubricant circulation
- high capacity in small cross section (C)
- long pregreased life
- efficient at high speeds
- mounted by press fit
- simple housing design
- low unit cost

INTRODUCING

a new low-cost precision roller bearing...

THE TORRINGTON DRAWN CUP ROLLER BEARING

For the first time, the advantages of drawn cup outer race construction are available in a precision roller bearing.

This compact, lightweight bearing consists of spherical end needle rollers, a one-piece hardened steel retainer and case-hardened thin-section outer race. Designed to run on a hardened shaft or with an inner race, this new series takes a press fit in a simple housing without snap-rings or shoulders.

Highly efficient roller guidance and lubrication are outstanding features. The shaft-riding retainer contacts the roller ends at the pitch line where guidance can be obtained with the least effort. The design provides ample storage for lubricant and promotes its circulation.

These features make the new bearing particularly suited to applications requiring compactness with precision, high-speed endurance or long pregreased life.

For information on sizes now available and for application assistance, call on our Engineering Department or write for the new bulletin, "Torrington Drawn Cup Roller Bearings." THE TORRINGTON COMPANY, Torrington, Conn. — and South Bend, Ind.

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • THRUST • BALL • NEEDLE ROLLERS

DEVELOPMENTS TO WATCH...

What's holding back titanium sandwich structures? . . .

. . . It's lack of a suitable titanium alloy foil and a satisfactory process for fabricating the panels. So says the latest report from the Titanium Metallurgical Laboratory at Battelle Memorial Institute. Commercially pure titanium is available in foil thicknesses, but it lacks the required strength. In fabrication, the biggest problem seems to be brazing the metal. Battelle believes "the brazing operation will have to be performed at aging temperatures," so brazing alloys that flow at these temperatures (in the 900 to 1180-F range) may have to be developed. Battelle gets good results brazing commercially pure titanium and the 6% aluminum–4% vanadium alloy with a 97% silver–3% lithium brazing material. But, says Battelle, "the amount of lithium in this alloy is rather high; therefore the corrosion resistance of this allow should be carefully investigated." There is, obviously, work still to be done.

Color specification may be easier . . .

. . . if a new unit now being developed for the tile industry moves out into other applications like home appliances and business machines. Called Chromosorter, the unit is designed to separate items on a tristimulus basis (hue, intensity, reflectivity) into as many as 27 groups. It's said to be three times as sensitive as the human eye to differences in any one of these factors. The unit has an optical scanner and three separate color channels–red, green, and violet–and can be used to analyze for all three tristimulus factors simultaneously, or for any one. Operation is fast (120 tiles a minute) and completely automatic; the manufacturer, Specialties, Inc., Syosset, Long Island, claims that special circuitry compensates for changes of as much as 11% in line voltage. Price of the tile machine is about $9,500. So far, no units have been built for other industries; but there is no basic reason why the idea couldn't be adapted for products like home appliances, as long as they have some reference surface.

Electrode-less gold plating can open new opportunities . . .

. . . for specifying plated coatings on parts where they have not previously been satisfactory, either from a production or performance standpoint. Newest process of this type is Baker & Company's "Atomex" for depositing 24-carat gold plate on copper, steel, die-cast alloys, nickel and other metals. It works by ionic displacement: The base metal, under chemical attack, sheds its atoms into the plating bath. These, in turn, are replaced by atoms of gold coming from the bath. Baker claims the deposits are unusually dense, needing less gold to achieve the desired effect; that the bond between base metal and coating is firmer than obtainable by other methods; that even complex parts can be plated uniformly. Suggested applications include electrical plug connectors, radio knobs, printed circuits (for protecting areas to be soldered), clock assemblies, auto and appliance trim.

LESS GOLD NEEDED, yet even complex little parts like these are said to receive better plating in the Atomex ionic-displacement process. No special equipment is needed.

Enameling aluminum may seem like painting the lily . . .

. . . but there are good reasons for it. For example, producers now say a porcelain-enamel coating can increase the strength of a finished part 30% or more. It also makes possible an almost-unlimited color range (even checkerboard color combinations); can improve thermal performance and weather resistance of aluminum parts; and provide a better bearing surface than the base metal. Big tonnage now, of course, is for structural applications such as aluminum curtain walls and windows. But Porcelain Enamel Institute forecasts for 1961 indicate 4 million sq ft of enameled aluminum could be used in appliances, transportation equipment, and military applications—as much as the entire construction field takes right now. Too, if current research comes up with an enamel suitable for cooking utensils and other such elevated-temperature uses, applications could be broadened still further.

Cranks, cartridges and spark plugs notwithstanding . . .

. . . startup is still a problem for designers of a good many machines. That's why the trend to improving the machine or motor itself—to make it easier to start—rather than just working on the starting mechanism.

B. P. Hess of Westinghouse points out, for instance, that applications for motors in farm areas, and in those industrial plants where only single-phase current is available, have been limited because in sizes above 10 hp, the starting-current requirement of single-phase motors was just too large.

By redesigning motor controls so main and auxiliary windings are in series during startup and can be switched to parallel operation for running, Westinghouse has come up with a 20-hp motor which, the company says, needs even less starting current than present 10-hp equipment (170 amp as compared to 204). Says Hess, "There is no longer any reason why restrictions need be made on the basis of horsepower alone." Expected applications for the larger-size motors include crop dryers, wood saws, and feed grinders.

Other data on the new 20-hp motor as compared to a conventional 10-hp unit. starting torque, 74 lb/ft vs 68 lb/ft; torque at transfer, 100 lb/ft vs 95 lb/ft; break-down torque, 140 lb/ft vs 60 lb/ft; current at transfer, 215 amps vs 200 amps.

Solar batteries . . .

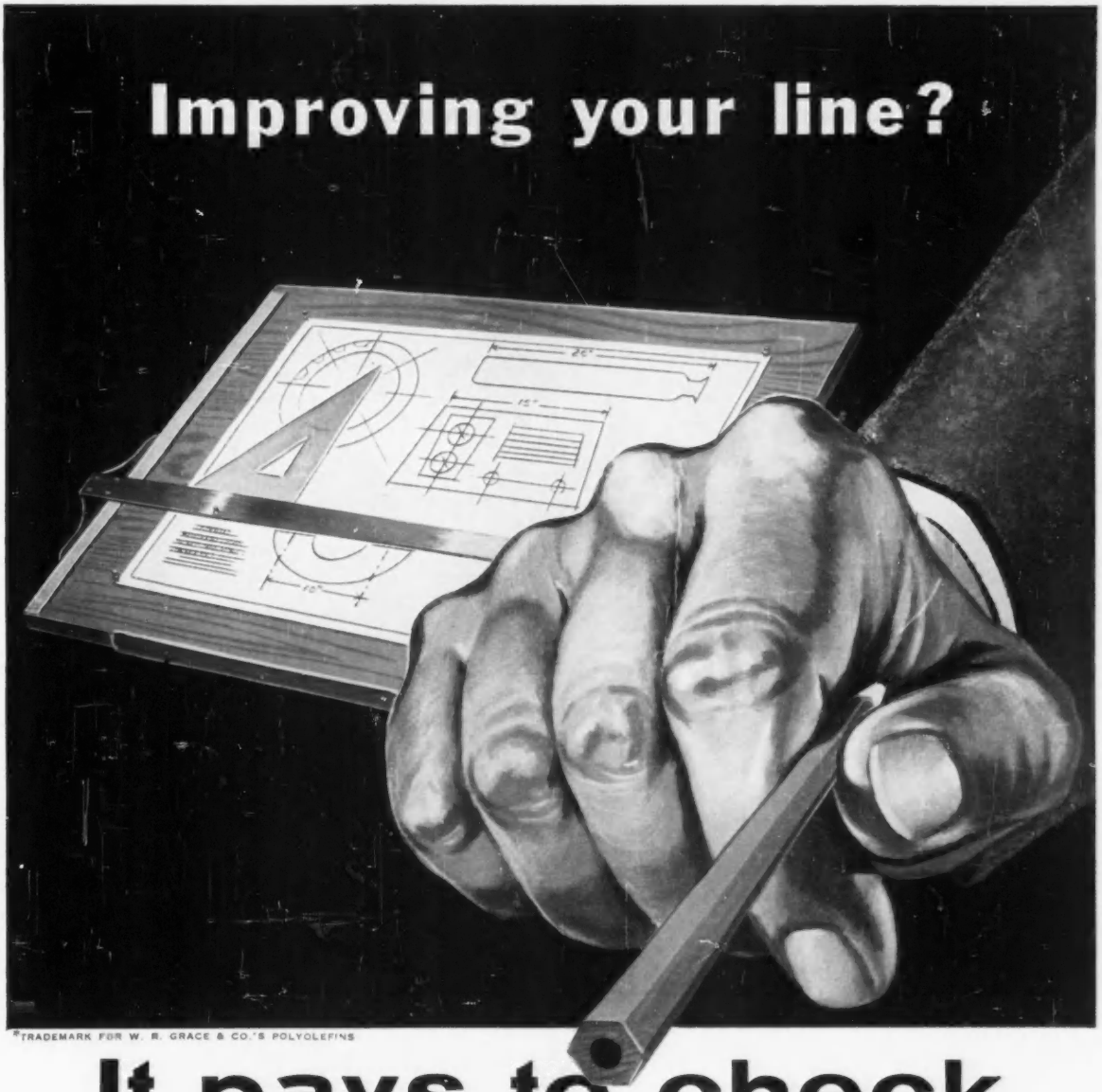
. . . silicon wafers that convert solar into electrical energy—are providing a field day for product design. Experimental units include a sun-powered flashlight, a radio phonograph, and the helmet radio pictured at the right; while sun-powered clocks and radios are already on the market.

All of these will operate on artificial as well as solar light, but many have been designed with auxiliary power sources to backstop their silicon cells. The radio phonograph, for instance, can be operated by six "flashlight-sized" batteries; and the Army helmet radio has small nickel-cadmium batteries for peak-power and nighttime operation.

Prices for solar-operated units range all over the lot. One clock is priced at $200, another at $1,000. The first sun-powered radio cost $250; but there is one on the market now for just $14.95. The latter is, of course, a rather simple unit, not much bigger than a pack of cigarettes. But it's said to give satisfactory local reception with its one silicon wafer, one transistor and one diode. The manufacturer is Acopian Technical Co., Phillipsburg, N. J.

SOAKING UP SUNSHINE, **double row of silicon wafers atop the soldier's headgear generate enough electrical power to run transmitter-receiver of standard Army helmet radio. It's a solar "first" from the US Army's Signal Engineering Laboratories at Fort Monmouth, N. J.**

Improving your line?



*TRADEMARK FOR W. R. GRACE & CO.'S POLYOLEFINS

It pays to check GREX*

It pays to check GREX . . . the newest in plastics . . . when manufacturing economy and product improvement are up for discussion.

GREX is true high density, high strength polyethylene. Its mechanical, chemical and electrical properties are significantly improved over many of today's most commonly used plastics.

GREX is recommended for plastic parts or objects destined for hard, prolonged usage, thanks to its high impact and tensile strength. GREX resists chemical attack, and can be used to contain corrosive acid. Highly resistant to heat, this new plastic can be boiled and sterilized, thus opening countless possibilities in the container, houseware, hospital and industrial fields. And its capacity for electrical insulation recommends GREX for the power and communications fields as well.

Until now, only the costliest plastics have offered these properties. GREX supplies them in *economical* form.

Tell us your plastic requirements . . . and we'll furnish full details and technical assistance to both you and your plastics molder.

W. R. GRACE & CO.
POLYMER CHEMICALS DIVISION

Plant
Baton Rouge, La.

Offices
Clifton, N. J.

American...

(continued)

DEVELOPMENTS TO WATCH...

Butyl rubber is bouncing back fast . . .

. . . and into a lot of new applications. It's being used to encapsulate electrical transformers, seal car windows, convey hot materials, and for a host of other applications. But its biggest coup to date is passing the Army Ordnance test as a primary material of construction for heavy-duty truck tires.

It had been written off as a dying material because its major application, tire tubes, disappeared with the advent of the tubeless tire. Now it's prized not only for its air retention but also for its low cost, electrical properties, resistance to aging, and ability to stand vegetable oils and fats. Tire applications were held back by difficulties in bonding the tire rubber to the tire cord. But Esso Research & Engineering has come up with a butyl latex dip that does the job—and paves the way for a whole series of latex adhesives that should broaden butyl's applications still further.

Precision-machined balls . . .

. . . for bearings, pivot points, valves and metering devices can now be ordered from stock—in a wide range of materials. Stocked items include at least eight different plastics (including nylon, Teflon, acetate, polystyrene sapphire, wood, ceramics, carbides and chromium-cobalt-nickel alloys. Some of these can operate in temperatures as high as 1500 F, and spherical accuracy can be held to 0.000005 in.

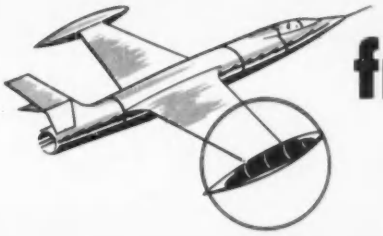
To achieve high temperatures at low cost . . .

. . . research groups are turning to solar furnaces. They're easy to build and use (several companies have made their own, from old Navy searchlights), and provide "clean" heat because there are no combustion products. Among those recently announced is one to be erected near San Diego by a group of eastern businessmen to research for industry and make salt water conversion studies; another being designed by Air Research and Development Command for erection in the Sacramento Mountains of New Mexico, and a third being built for Stanford Research Institute at its Menlo Park, Calif., headquarters, for development of special high-temperature materials. Temperatures reached by the furnaces are expected to be at least 6000 F, and one may go as high as 8000.

Can we throw it away? . . .

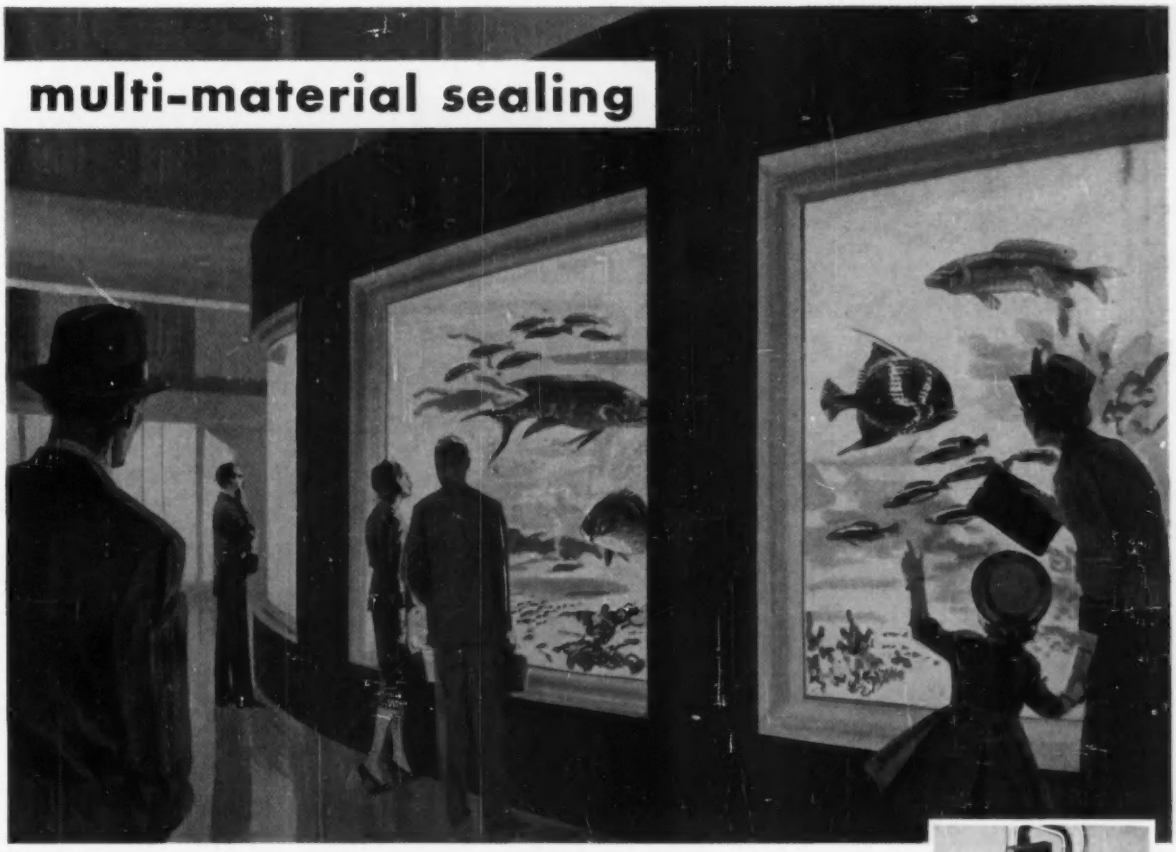
. . . That's a question you'll be hearing often from now on. Ever-increasing maintenance and repair costs are directing new emphasis to components that can be made expendable. (There's emphasis on durability too, of course, but that's another story.) A new gun for applying sealing and caulking compounds has molded plastic nozzles that can be thrown away after use, don't have to be cleaned and stored. Disposable carbide and ceramic toolbits are saving on sharpening costs; one-shot disposable cartridges for lubricants simplify storage and greatly reduce the danger of contamination.

PAPER DRESSES **(suits too) are not just wishful thinking. Central States Bag & Paper Co. turned out this dress to show it can make clothing durable enough for a day's outing even if it rains, and good-looking enough for street wear. Cost is still a barrier, but disposable work clothing, at least, could be available quite soon.**



from FUEL TANKS to FISH TANKS

multi-material sealing



Elastomeric sealants based on* THIOKOL *liquid polymers effectively bond most materials

Metal fuel tanks for jet aircraft require leakproof seams. Aquarium tanks, above, have glass-to-metal and metal-to-concrete joints that must be 100% watertight. THIOKOL polymer-base compounds do both these sealing jobs, pointing up their ability to efficiently seal and bond a wide variety of materials.

With all materials, THIOKOL polymer-base elastomers retain high adhesion throughout severe expansion and contraction, shock and vibration. They resist major causes of deterioration—sunlight, ozone, oxygen, water, and solvents—and give you assurance of continuing protection for many years.

There is a versatile, durable THIOKOL polymer-base compound for *any* sealing job you have. For specific information, see Sweet's 1957 Catalog or write: Thiokol Chemical Corporation, 780 North Clinton Avenue, Trenton 7, N. J. In Canada: Naugatuck Chemicals Division, Dominion Rubber Co., Elmira, Ontario.

The new New York Aquarium tanks are sealed with DEL, an elastomeric sealant based on THIOKOL liquid polymers and compounded by David E. Long Corporation, New York.

Thiokol®
CHEMICAL CORPORATION

®Registered Trademark of the Thiokol Chemical Corp. for its liquid polymers, rocket propellants, plasticizers and other chemical products.

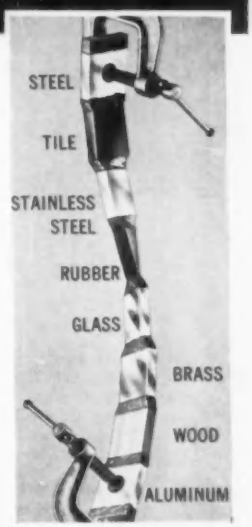
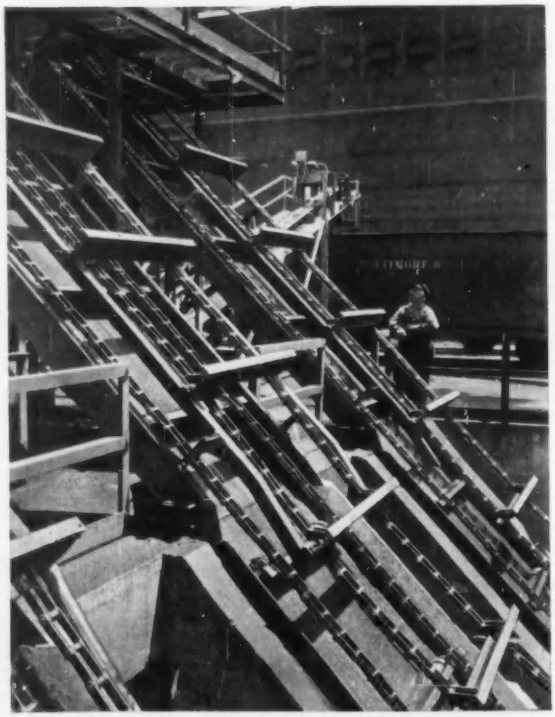
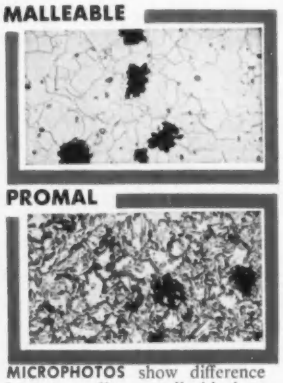


Photo illustrates multi-material adhesion ability of THIOKOL polymer-base sealing compounds.

Specify longer-lasting Link-Belt Promal chains for extra durability





MICROPHOTOS show difference between ordinary malleable iron and Promal. Upper—white areas in malleable microphoto represent "free-iron". . . black shows soft nodules of carbon. Lower—the dark areas in the Promal structure show stronger, stiffer reinforcing material which strengthens metal and resists distortion and wear.

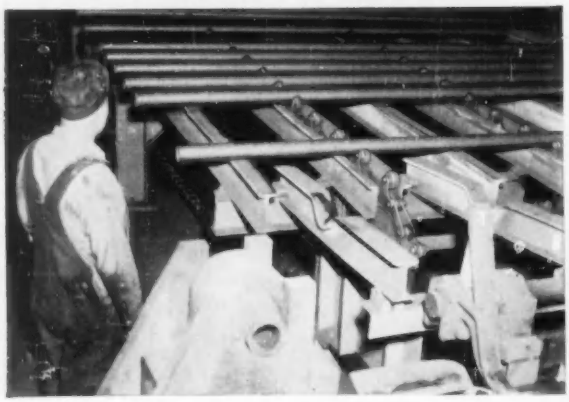
◀ **UP TO 475 TONS** of steel mill scale a week are recovered by this Link-Belt system. Class 700 Promal chain on Straightline Collector moves scale from settling tanks to discharge conveyor. Promal is especially suitable for long heavy-duty conveyors and elevators.

Specially heat-treated malleable iron provides extra wear resistance

Fewer conveyor shutdowns and minimized replacements are economies realized by users of Link-Belt Promal chain. Its greater strength absorbs continuous impact loads — and wear resistance supplies the durability to cope with severe abrasion.

Promal is more than a partially annealed or surface-hardened malleable iron. Developed by Link-Belt, this specially heat-treated malleable iron is actually transformed into a metal of radically different physical properties. Promal, because of uniform micro-structure throughout its whole section, provides greater ultimate strength, higher yield point, exceptional fatigue resistance and a remarkable capacity to withstand abrasion.

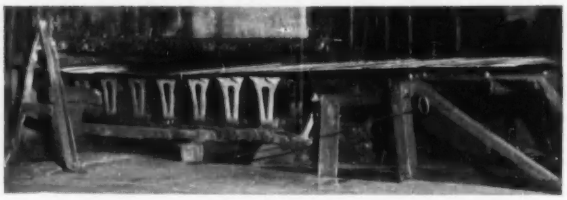
For unusually abrasive or mild corrosive conditions, Promal chain can be furnished with "file-hard" surfaces. Copper bearing or special alloy content also available.



Where and how to apply Link-Belt Promal Chains

Choose Link-Belt Promal chains for highly abrasive conditions—for extra strength and wear resistance demanded by heavy loads or long, sliding conveyors. They last much longer . . . cost but a little more.

The wide range of Link-Belt chains available in Promal includes all types of cast and combination chains.



HEAT-RESISTANT PROMAL is recommended for temperatures up to 1000 F. This SMGL-618 Promal chain conveyor with riser attachments picks up and conveys sheet steel through furnace. Chain has operated continuously for two years without failure.

Promal chain controls uniform cooling of pipe

An inclined conveyor, using Link-Belt Class 1100 Promal chain with attachments, permits an Ohio steel mill to control cooling of longer tubes than previously possible. Pipe is received from hot finishing operations at temperatures up to 1800 F. Controlled chain speed permits uniform cooling of outer tube periphery.

HEADQUARTERS for chains, sprockets and other Link-Belt conveying and mechanical power transmission products is your nearby Link-Belt office.

LINK-BELT

CHAINS AND SPROCKETS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,281-A

DEVELOPMENTS TO WATCH...

Faster acceptance (or rejection) . . .

. . . of new equipment designs could be on the way if other services adopt a setup now going into operation at Fort Rucker, Ala. Here, Army has established a Transportation Aircraft Test and Support Activity (TATSA) which will attempt to cut time required for full-scale logistical evaluation of new aircraft from several years to a few months. Army hopes for quick answers to such questions as the probable life of component parts, and future supply and maintenance requirements. It should be able to uncover design deficiencies faster, too.

Equipment is first given a limited 300-hr test. If it proves out, it is pushed into a 1000-hr "breakdown" program. One new helicopter is under test now, and three more (including the French-made Djinn) are scheduled for evaluation in the near future.

The revolution in war materiel . . .

. . . when guided missiles become operational, may be far greater than most persons realize. While the spotlight has been on replacing manned aircraft by missiles, the fact is that a good many other types of equipment may also be replaced.

E. V. Murphree, president of Esso Research & Engineering and, until recently, the nation's guided-missiles "czar," says there is good reason to expect that surface-to-air missiles like Nike, Taos and Terrier could do many jobs now done by anti-aircraft artillery; and surface-to-surface missiles like Redstone, Matador and Regulus could replace several types of ordnance equipment, including the big "atomic guns." The changeover will be some time in the making, and it may not be complete, but Army has already begun to close its own ordnance plants, and it looks like ordnance as well as aircraft designers had better start hunting for new products.

Don't taper off on design expenditures . . .

. . . for fission-reactor equipment with the thought that this type of "atomic furnace" will soon be replaced by the controlled thermonuclear (fusion) reactor. That's latest word from the Joint Committee on Atomic Energy. Its most recent report says the fusion program (Project Sherwood) is "a very long-range program which should not discourage efforts of fission-reactor builders." Another tip-off: The original fission program cost $2 billion. Current Project Sherwood appropriation is $7½ million.

Add "Human Barrier". . .

. . . to the list of terms you'll be hearing a lot more often in reports from Washington. There's nothing new about it, of course, but human limitations are becoming a major bottleneck in designing everything from ships to rockets. The cramped conditions of small crowded cabins have long been a problem in submarines. And the ability of people to stand confinement for long periods could be as severe a limitation on space flight as any materials or design problem. But a submarine cabin will seem like the Hollywood Bowl compared to the cabin of a satellite-bound rocket.

Latest attempt to crack this human barrier is a joint effort by the Air Force's Aero Medical Laboratory, Wright-Patterson Air Force Base, and Lockheed Aircraft Corp. Lockheed will build a full-scale (6-by-7-by-17 ft) mockup of a "flight station," and teams of psychologists, biologists, electronics and communications engineers will study reactions of men confined for several days at a time.

Technical data on neptunium . . .

. . . element 93 (see page 16) should be coming from Oak Ridge National Laboratory in the not-too-far-distant future. Until now, very little has been known about this element's chemical and physical properties because not enough of its long-lived isotope (neptunium 237) was available to permit analysis. Now, though, Oak Ridge has a new separation process that has made it possible to recover several pounds of the element from reactor wastes, and a study of its properties has begun.

Advertisement

Design data on adhesives

Armstrong

NUMBER THREE

ADHESIVES • COATINGS • SEALERS

Strengthening a metal-to-metal joint

Four basic rules must be kept in mind in order to strengthen any joints to be adhesive-bonded.

These rules are:

1. Make the bonded area as large as possible.
2. Make the maximum proportion of bonded area contribute to strength.
3. Stress the adhesive in the direction of its maximum strength.
4. Minimize stress in the direction in which adhesive is weakest.

Here's how two of these rules were applied in improving the bond of a metal label to a fire extinguisher.

A

This label was designed for fastening with rivets. The label is flat, has embossed letters, and has holes drilled for riveting. Contact is very poor because of the embossing, resulting in low strength and low resistance to peel or cleavage stresses on the edge of the joint.

B

Remedy

This label was designed for adhesive bonding. The label is pre-curved and has a smooth back for 100% contact. This type of bond will prevent failure when a stress is applied at the edge of the bond with a fingernail or, for example, with some sharp instrument.

1. Bonded area has been made as large as possible.
2. Maximum proportion of bonded area now contributes to strength.

If you have a design problem involving adhesive bonding, we may be able to suggest a practical, economical solution based on our 36 years of experience in making and using adhesives, coatings, and sealers. Send details of your problem to Armstrong Cork Company, Industrial Div., 8009 Irvin St., Lancaster, Pa.

Factors in adhesive bonding

Most assembly requirements for adhesive-bonded materials include factors of time, heat, and pressure. These vary with the adhesive used and also with the materials bonded.

Time

Two time factors are involved, open time and setting time. Open time is the period of time that can or must elapse between coating the parts and joining them. Some adhesives permit little open time; others must be kept open for intervals ranging from five minutes to twenty-four hours.

Setting time is the period that must elapse before an adhesive bond attains its full strength. Here again the interval may be measured in seconds or weeks, depending upon the adhesive, the materials bonded, and the curing procedure, if any.

Heat

Heat is required in varying degrees in many adhesive applications. Whether one or both surfaces are coated, forced drying of the adhesive film by heating and circulating air is usually desirable and often necessary. The use of heat speeds drying, makes drying independent of weather conditions, and prevents water condensation on the adhesive film.

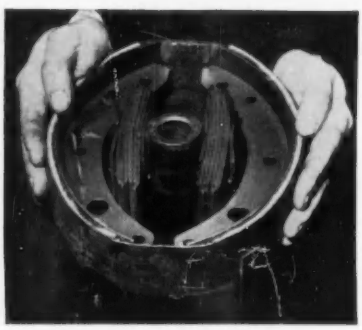


PHOTO COURTESY CHEVROLET-DETROIT GEAR AND AXLE DIV., GENERAL MOTORS CORP.

ADHESIVE-COATED brake shoes and brake bands are assembled on a conveyor line. The brake band is first placed inside a pressure band and against the brake shoe. Pressure springs are then positioned. The assembly is then baked.

Controlled drying also makes it easier to begin assembly when the adhesive film has the right amount of tack, this being the point at which the best over-all bond can be made. Under some conditions, it may be more practical to dry the adhesive film completely and later reactivate it with heat or a solvent.

Special Factors

Thermosetting adhesives, which set by a chemical change in the presence of heat and/or a curing agent, require special assembly techniques. Adhesives of this type are most always used in critical applications where the possibility of bond failure cannot be tolerated—as in the bonding of clutch facings to steel plates. Since such bonds cannot be tested except by destruction, they must be made with extra care and control.

Curing

Some thermosetting adhesives must be cured by chemical reaction at room temperature, the bonded parts remaining clamped for a relatively long period of time. Oven heating of assemblies is quite common. Ovens may be heated by gas, oil, electric, or by infrared units. Forced circulation is required by oven heating in order to insure uniform temperature. The fastest curing time is accomplished by dielectric heat, which cures some heat-set adhesives in a few seconds.

Thermosetting adhesives may be cured at temperatures from 75° to 550° F., depending on the specific type. In general, the higher the temperature, the faster the cure. By controlling temperature, the bonding operation can be speeded or slowed to match the pace of almost any assembly line. Parts bonded with thermosetting adhesives usually can be taken from the presses while still hot.

For detailed information on bonding thermosetting adhesives, see the Armstrong Data Sheet, "Thermosetting Adhesives." It is available upon request. Write for your copy today.

Foreign...

DEVELOPMENTS TO WATCH...

New steels . . .

. . . said to out-perform the best now available are popping up both sides of the Iron Curtain. Britain's Fulmer Research Institute reports a "low-cost, oxidation-resistant, 2½% silicon-1% aluminum, mild steel" that "costs only one-third as much as 18-8 stainless, yet offers comparable resistance characteristices in the 1600 to 1700-F range." At the same time, it "avoids the brittleness associated with high-silicon steels." Tensile strength is about equal to mild steel. Strength can be increased by adding tungsten and molybdenum—but this would add to the cost.

The Institute also announces a new technique for producing large high-purity silicon crystals and a new aluminum-copper-cadmium alloy for precision-machined components.

From Russia comes word of another new steel, also for high-temperature use (1500 to 1600 F). It contains 13% chromium, 4% nickel, and 9% manganese and, of course, is said to be "superior to all similar materials in America and West Europe."

Man-made interference with radio reception . . .

. . . is becoming a problem around the world. Military agencies, concerned about it for some time, have set up standards for equipment design. But, increasingly, radio interference must be considered by designers of consumer products—and not just in the US. For instance, Britain's Kenwood Manufacturing Co., Ltd., is emphasizing as a major feature of its new spin drier the large direct-drive induction-type motor which "unlike many driers that are V-belt driven cannot cause radio or TV interference."

Brazil is building its own autos . . .

. . . for the first time. A small, lightweight, 2-cylinder 2-speed model is just going into production at the Romi Santa Barbara do Oeste plant west of Sao Paulo. The car, which weighs less than 800 lbs., is oval in shape—allowing a wrap-around door in front of the driver. Brazil's official trade bureau says the car will seat two or three persons without discomfort to them, or overloading the car.

More horsepower per pound . . .

. . . than any other vehicles of their type. That's the proud statement Husquvarna of Sweden makes about its new motorcycles, soon to be introduced in the U. S. Extensive use of aluminum helps hold down the weight. The machines have chrome-plated aluminum cylinders, as well as aluminum wheel rims and mud and chain guards.

There are two models. One has a 9-hp motor; the other 10.5. Both have three gear positions besides Neutral, and top speed is over 60 mph, yet the machines weigh only about 150 lb.

Other features: speedometer built into the headlight and operated from the gear box; a tool kit built into the framework under the seat; the deluxe Golden Arrow model has a gold-laced foam-rubber seat cushion.

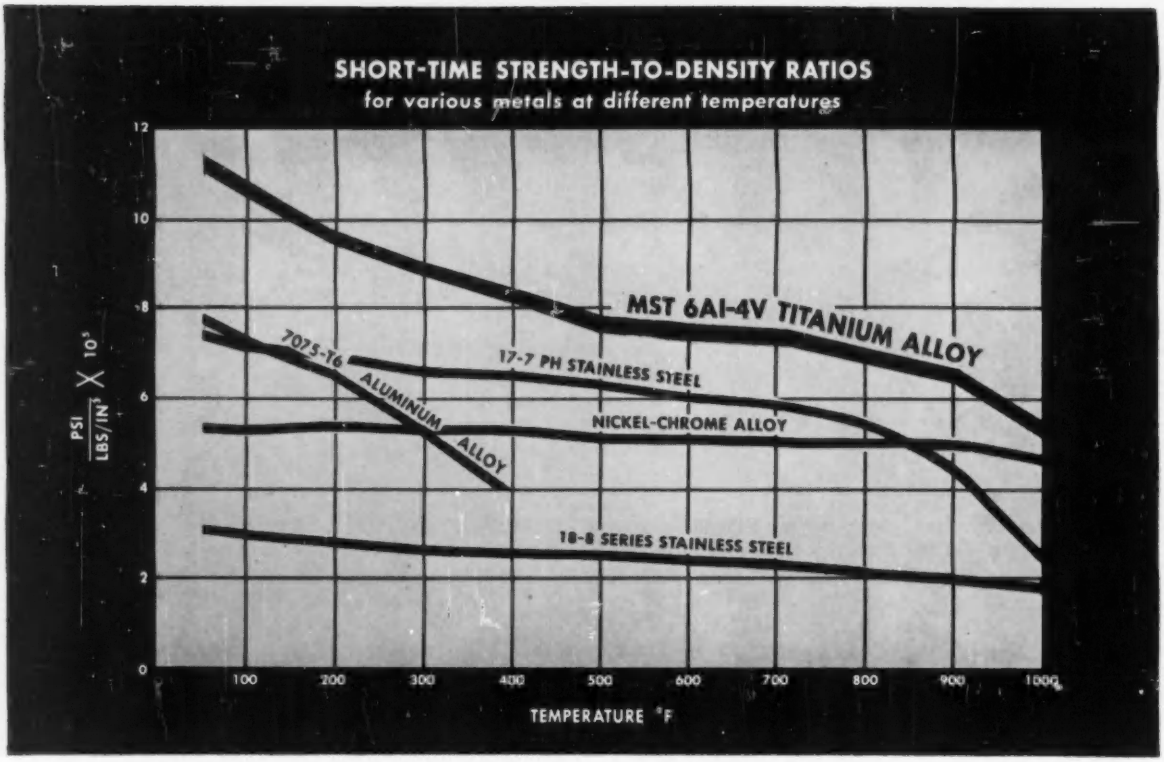
From rocket engines to lenses . . .

. . . Japan, too, is pioneering in plastics. Recently patented in Tokyo is a new plastic, specifically developed for lenses, prisms, and the like.

Japan External Trade Recovery Organization says it is three times as hard (and scratch-resistant)) as any materials now available for the purpose; has good dimensional stability and resistance to breakage.

As to rocket engines, Prof. Hideo Itakawa of the University of Tokyo's Institute of Industrial Science is said to have built and successfully tested one made almost entirely of glass fiber-reinforced plactic. It weighs about half as much as a conventional motor, is to get its first official tryout in a rocket balloon to be launched later this year.

Incidentally, Japan now claims fourth place—just behind Germany—in world plastics production. Current output is about 680 million lb a year. (US production: about 4 billion.)



TITANIUM ON TOP

in medium-high temperature range

Today's most popular titanium alloy, MST 6Al-4V, excels all other metals in strength to density ratio through 900°F. At room temperature, considering only strength, a part made of this alloy need have only 60% of the weight of the equivalent part in stainless steel.

Performance for extended times at elevated temperatures is likewise good. In typical creep tests, with 1% permanent deformation allowed, MST 6Al-4V alloy shows 100,000 psi allowable stress at 750°F for 1 hour; 77,000 psi at 100 hours; 65,000 psi at 1000 hours.

Meanwhile new alloys extending the elevated temperature usefulness of titanium—to as high as 1000°F—are now emerging from the laboratory into production.

Write Dept. P-5 for copy of "Titanium Alloy Properties"

SELECTION GUIDE TO MST ALLOYS

Typical Mechanical Properties of Annealed Titanium and its Alloys

	Form	Ultimate Tensile Strength, psi	Yield Strength, psi	Elongation %*
COMMERCIALLY PURE TITANIUM				
MST Grade III	Sheet, Bar	70,000	50,000	25
(3 different strength levels)	Sheet, Bar	85,000	65,000	23
	Sheet, Bar	100,000	80,000	20
TITANIUM ALLOYS				
MST 6Al-4V				
Annealed	Bar	140,000	130,000	15
Age hardened (1)	Bar	165,000	155,000	12
Age hardened (2)	Bar	180,000	165,000	10
Annealed	Sheet	140,000	125,000	12
MST 3Al-5Cr	Bar	155,000	145,000	13
MST 4Al-4Mn	Bar	150,000	140,000	14
MST 8 Mn	Sheet	137,000	125,000	16

(1) 1650°F—1 hour—WQ; 1100°F—2 hours—AC
(2) 1700°F—1 hour—WQ; 1000°F—8 hours—AC

WQ—Water Quench
AC—Air Cool

* Values for 1" on bar and 2" on sheet

MALLORY Ti SHARON

MALLORY-SHARON TITANIUM CORPORATION · NILES, OHIO

Producers of titanium and titanium alloy sheet, strip, plate, rod, bar, billets

Foreign...

DEVELOPMENTS TO WATCH...

(continued)

Poland claims the smallest industrial TV camera . . .

. . . and it doesn't use transistors, either. Said to weigh only 4.2 pounds, the unit is 7.4 by 3 by 4.6 in. and has simplified circuitry and miniaturized components. Why no transistors? No prejudice against them, apparently. It's just that transistors are not yet available in Poland. When they are, conceivably an even smaller unit will be produced.

Russia, incidentally, does have transistors. But production is still limited, and applications are presumably all military.

Model engines are getting so efficient . . .

. . . they're putting real ones to shame. The latest group, from Bragenitz & Eberth of West Berlin, has eight different models, including "the world's most powerful 1.5 and 2.5-cc engines." Carrying a six-months guarantee, they feature sand-blasted crankcases dip-sealed against corrosion and leaks.

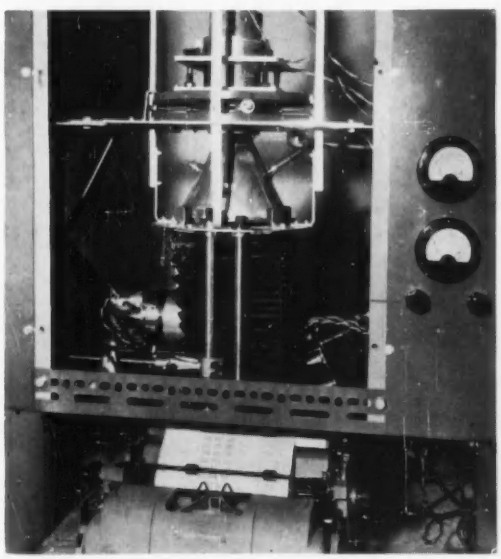
Also new from West Germany: automatic and semi-automatic grinding machines specially designed for bicycle manufacture—handlebar grinding and polishing machines, polishers for iron base plates and other flat surfaces, and tube and pipe models that can be set up in tandem.

A reading machine . . .

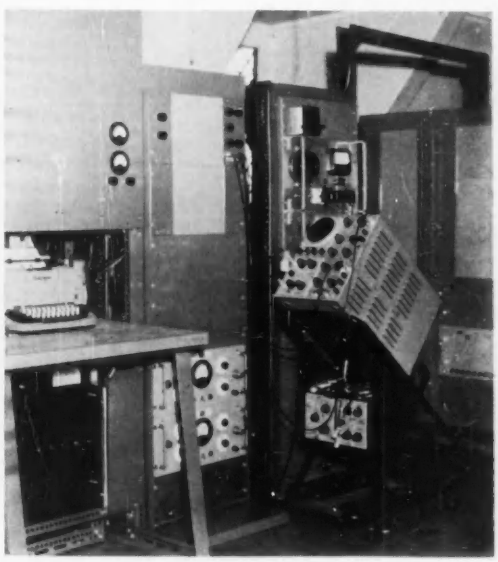
. . . that will scan "any document"—even microfilm, checks, and tally rolls—at the rate of 300 or more characters a second has been developed in Britain. It can even read smudged and blurred characters, its developer says, and makes it possible to feed information to a computer as fast as the machine can accept it.

The machine, built on the modular principle, features all-electronic scanning, can be tied in with computers, card-punchers, paper-handling devices. Primary output consists of pulses corresponding to the character being scanned—one pulse per wire. These pulses can directly operate a keyboard or sorter, or they can be stored in binary form.

A joint company, to be known as Rheem-Solartron, Ltd., is being formed by Solartron, the original developer, and Rheem Mfg Co of New York for further work on this and other electronic devices.



ELECTRONIC EYE **of British machine is flying-spot scanner shown poised above typewriter that tests operation.**



Oscilloscope shown above checks pulse-processing circuits. Behind it is the control-panel system.

What's happening in SCIENCE

Electronic devices for your tickler file

New developments in electronics promise big things for the future. But it will probably be three to five years before such devices as spacistors, solions and cryotrons are ready for general use.

Raytheon's spacistor, for instance, promises to combine the small size and simplicity of a transistor with the high-impedance, high-frequency operation of a vacuum tube. Eventually, it may be able to operate at temperatures as high as 900 F. So far, though, less than a dozen units have been made—and these only to demonstrate the principle.

Navy's solion, which uses a liquid as the charge carrier ("solion" is derived from ions-in-solution), is scheduled for a use in integrator units for aircraft guidance systems. Later on, it may go into "rate circuits" for burglar and fire alarms, furnace regulators, and pressure indicators. But none of these has yet had a tryout.

The cryotron, a low-temperature electronic device announced by MIT several months ago, may be even farther from general commercial application, though it's already being used in computer construction. It takes advantage of superductivity—the ability of some metals to conduct current at extremely low temperatures (below 420 F). The cryotron won't work at room temperature, however, so special refrigeration (in this case, a liquid helium bath) is needed.

New route to titanium-clad steel

One way to take advantage of titanium's corrosion resistance without boosting equipment costs to the danger point is to clad low-cost steel with it. But producing a good clad sheet has presented problems, notably formation of intermetallic compounds that interfere with adhesion and ductility. Now, though, Armour Research Foundation and Oak Ridge National Laboratory report progress:

Thin sheets of vanadium and copper interleaved between titanium cladding and the metal base make it possible to produce a good, ductile bond by hot-rolling the metals together. Next step: developing commercial production methods, including a satisfactory welding technique. (See Sept 16 issue for the full story.)

Another element makes its debut

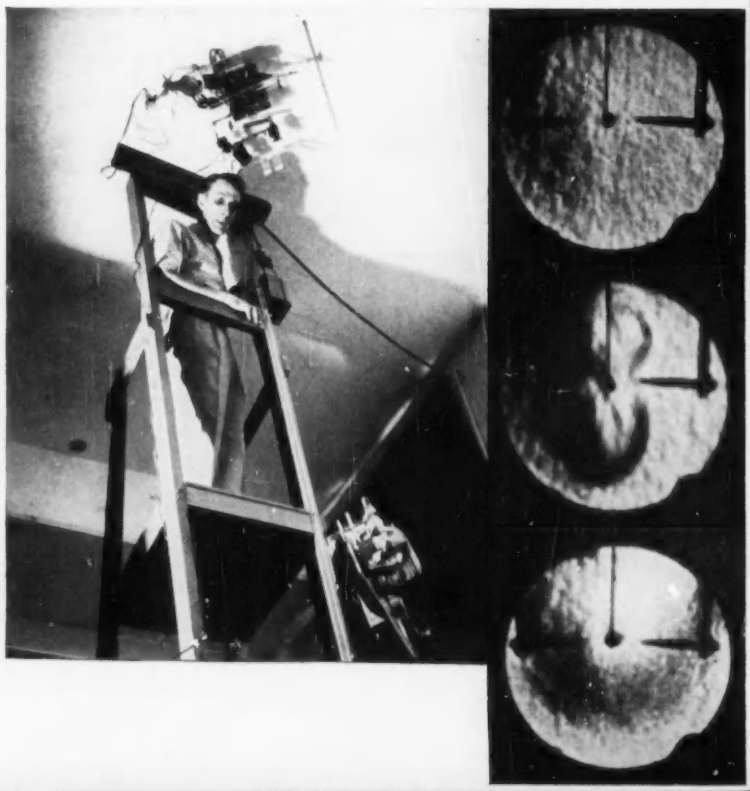
Add nobelium, element 102, to the periodic table, but don't expect to use it as a structural material. Recently created in a cooperative triple play involving US, British and Swedish laboratories (Argonne, Harwell and the Nobel Institute), nobelium has a half life of only 10 to 12 minutes. Still, it's an important confirmation of previous theory, and a promise of more elements to come. Counting up from uranium (element 92), the list now stands: 93, neptunium; 94, plutonium; 95, amedicum; 96, curium; 97, berkelium; 98, californium; 99, einsteinium; 100, fermium; 101, mendelivium. The newcomer's symbol is No. It's the next-to-last member of the actinide series, and has properties similar to thorium. Number 104 should be much like 103; but 105 is expected to be closer to hafnium and zirconium.

Shortcut to space studies

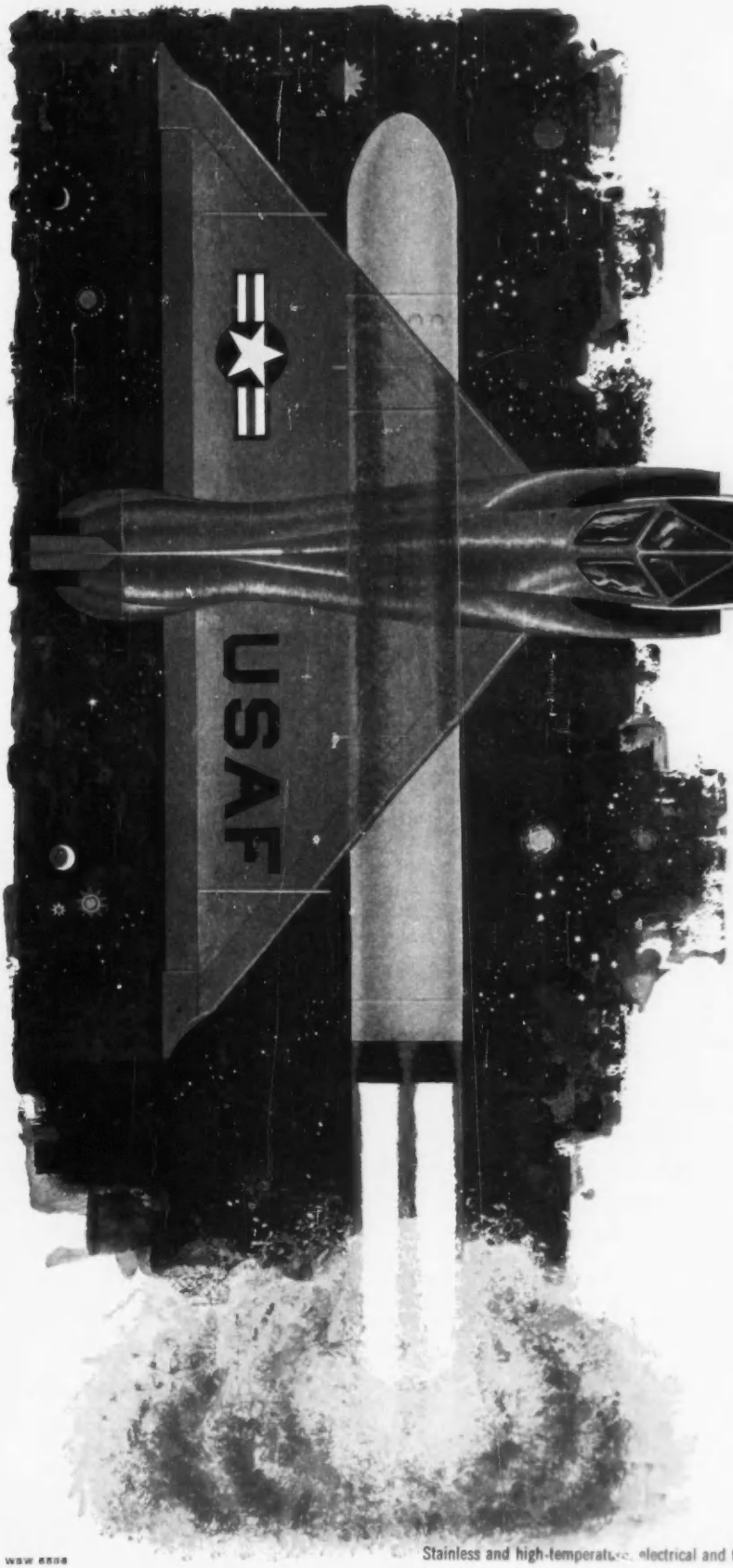
How to simulate outer space and obtain vital design data, without waiting months for special test facilities, is a problem a lot of laboratories are facing. General Electric's Research Laboratory solves one such problem with the simple setup pictured at the right.

Here, the question was: How does fuel burn in gravity-free outer space? Answer: There is a good flame, but it takes on a spherical rather than a vertical shape, as shown in photos at right.

To obtain them, GE engineers working under the direction of Dr. George Moore devised a glass combustion chamber, with built-in ignitor, light source, and camera, and dropped it down a stairwell. Gravity-free conditions are simulated during the fall.



FREE-FALLING FIREBALL . . .
dropped down stairwell, gives GE engineers an idea of how fuel will burn in gravity-free outer space. Sequence at right shows three stages in burning process. Photos were taken by camera built into circular glass combustion chamber.



something of your future was on our minds yesterday

Who can gauge the portent of things like jet and rocket flight, gas turbines and guided missiles? Electronic computers and automation, television and radar? Fission products and atomic power?

Already some of them are giant industries. They affect your personal life, your business planning, your entire world outlook. Yet each would still be an improbable dream except for the electrical alloys, special steels, and other corrosion and heat-resistant and special-property metals (such as titanium and zirconium) that will do today what could not be done yesterday.

It is Allegheny Ludlum's continuing job to pioneer, research and perfect such metals—and more important, make them available in the commercial shapes, forms and sizes that you need. ● Call on us for *any* engineering assistance. ***Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pa.***

ALLEGHENY LUDLUM ®

PIONEERING on the Horizons of Steel

WSW 6808

Stainless and high-temperature, electrical and tool steels; magnetic materials and sintered carbides

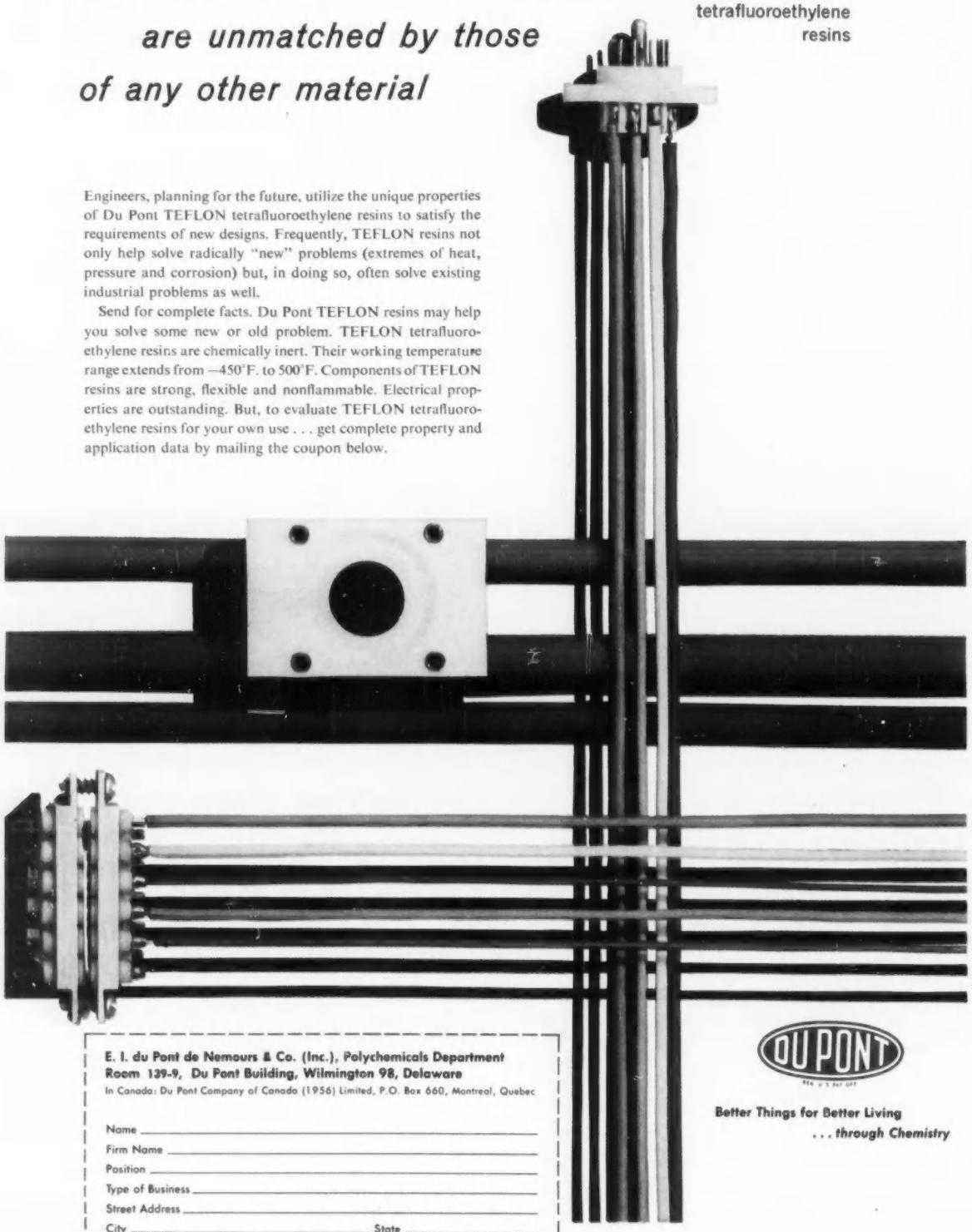
the properties of DuPont **TEFLON®**

tetrafluoroethylene resins

are unmatched by those of any other material

Engineers, planning for the future, utilize the unique properties of Du Pont TEFLON tetrafluoroethylene resins to satisfy the requirements of new designs. Frequently, TEFLON resins not only help solve radically "new" problems (extremes of heat, pressure and corrosion) but, in doing so, often solve existing industrial problems as well.

Send for complete facts. Du Pont TEFLON resins may help you solve some new or old problem. TEFLON tetrafluoroethylene resins are chemically inert. Their working temperature range extends from —450°F. to 500°F. Components of TEFLON resins are strong, flexible and nonflammable. Electrical properties are outstanding. But, to evaluate TEFLON tetrafluoroethylene resins for your own use . . . get complete property and application data by mailing the coupon below.



E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 139-9, Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada (1956) Limited, P.O. Box 660, Montreal, Quebec

Name _____
Firm Name _____
Position _____
Type of Business _____
Street Address _____
City _____ State _____

DU PONT

Better Things for Better Living
. . . through Chemistry

Strong aluminum plate made for structures

Designated Alloy 5456 by its producer, Aluminum Company of America, a new composition is being rolled into plates said to have the best mechanical properties available in the nonheat-treatable alloys. Plate is produced in "O" and "H321" tempers, and ranges in thickness from 0.250 to 2 in. Typical mechanical properties of Alloy 5456-H321 are 51,000-psi tensile strength, 37,000-psi yield strength, and 16% elongation.

Besides good corrosion resistance, the material has excellent welding characteristics and can be joined by the resistance, tungsten arc, and consumable electrode methods. Tensile strength of welds exceeds the 42,000-psi minimum tensile strength guaranteed for Alloy 5456 in the annealed temper. In addition, the alloy meets US Navy needs for greater strength in aluminum plate for gun mounts, carrier elevators, deckhouses and other shipboard installations. The plate is also suited for overhead cranes, ship unloaders and heavy-duty structures.

Zinc undercoat helps

A thin layer of zinc between steel and the copper-nickel-chrome plating sequence is key to a rust preventing technique developed by Wagner Bros., Detroit. With this method, rust cannot work up through minute flaws in the plating; easily removable zinc oxide appears instead. Practical application has been stymied by molecular affinity between zinc and adjacent copper. Plated parts in a 20% salt spray at 212 F for 192 hr. show no rusting, blistering, cracking or peeling. **Mild steel** takes on some of the essential characteristics of stainless when coated by a process called Niphos by its developer, the New York Testing Laboratories. The coating, a new nickel alloy, can be applied to all shapes, and is then heated in a reducing atmosphere. Tests show no flaking of the cladding during a 180° bend.

Pellet electrode helps vacuum-melt metals

Research at General Electric indicates that pellets turned into electrodes for vacuum furnaces may simplify production of high-quality ingots of titanium and other refractory metals such as molybdenum, zirconium and tantalum. Developed as a research tool by Stanley Noesen of GE's Research Laboratory, the new technique (above) introduces pre-formed metal pellets, on a vibratory feeder, into a standard cold-crucible vacuum arc-melting furnace.

After automatic indexing and stacking, the pellets are sintered by a heavy electric current to give a homogeneous electrode. As fast as it grows, the electrode is arc-melted into the water-cooled crucible. Resulting ingots are extremely low in oxygen content, about 1-2 ppm, an important factor in fabricating refractory alloys.

Another advantage: The heavy electrode press in present methods is replaced by a simple pill-making press that can be run as a separate operation. Prototype equipment at GE is limited to 500-lb. ingots, too small as yet for present titanium production rates. Scaled up, with pellet diameters of about 8 in., the new process could easily compete with the existing prepressed sponge electrode process.

BRIEFS

NEW ENTRY in urethane rubber is Genthan S, from General Tire and Rubber Co., and first wholly US-developed product in a field dominated by Germany. Genthan S features wider range of useful temperatures and easier in-plant handling than present urethanes.

TANTALUM METAL-POWDER PRODUCTION begins next month and ingot production will follow at Fansteel Metallurgical Corp.'s new tantalum-columbium plant going up near Muskogee, Oklahoma. Most of the output is scheduled for tantalum capacitors.

NINE SPECIAL MASTER ALLOY formulations for producing a specific titanium-base alloy without other additions are available from Electro Metallurgical Co., Div. of Union Carbide Corp. They will speed formulation and mixing.

WATCH FOR STEPPED-UP DEVELOPMENT of columbium as an alloy for future jet engines. The military services and the AEC are pressing for work on this metal, big deposits of which have been found in Idaho and Canada.

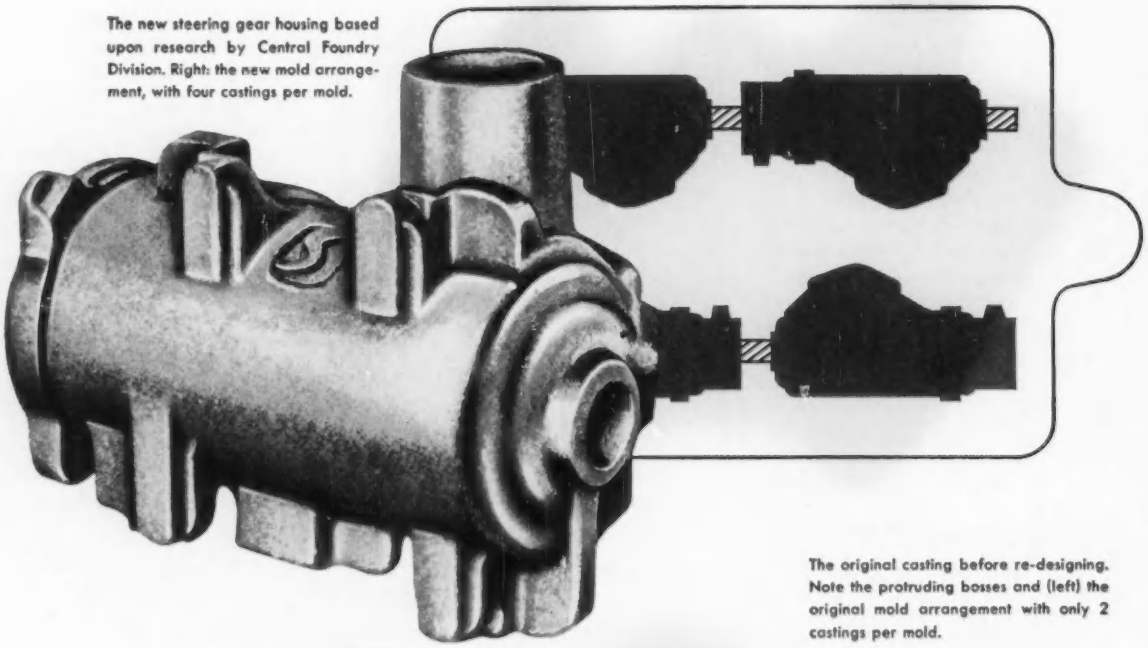
SINTERED ALUMINUM-OXIDE POWDER PARTS are available from Alcoa as extruded shapes, forgings, sheet, foil, drawn and extruded tube, impact extrusions, fasteners, and wire.

New toughness test for titanium

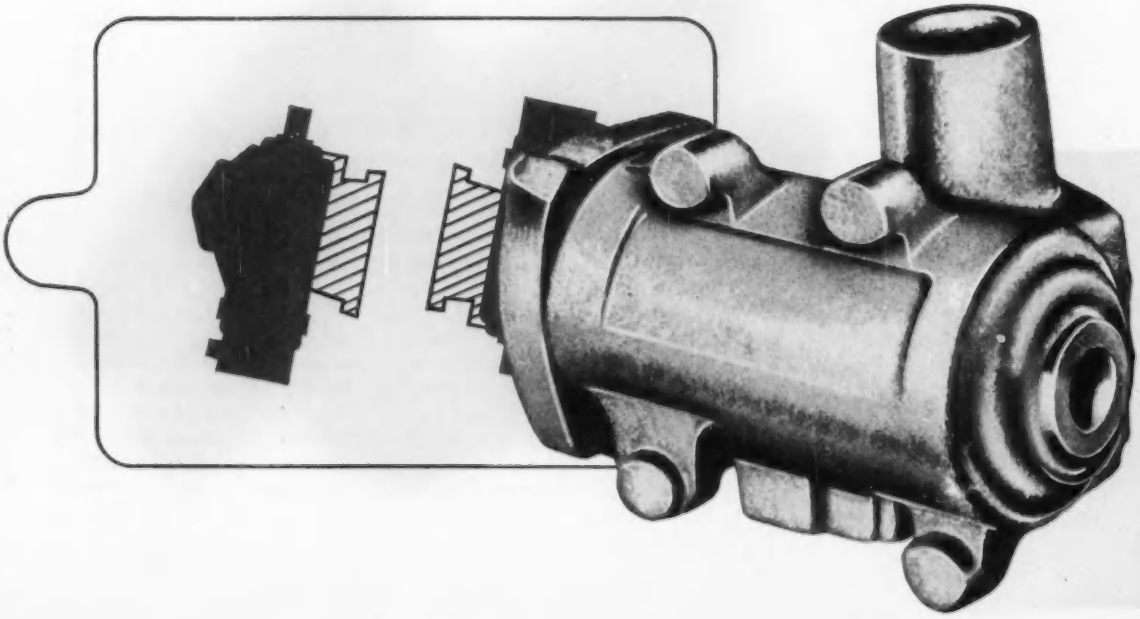
Battelle Institute of London, England, reports it has developed a new method of micro impact testing to determine toughness of titanium alloys. It needs less than 15% of the material required for conventional tests using Charpy V-Notch specimens. Battelle has successfully used its technique for detailed toughness tests of titanium alloys machined from ¼-in. diameter rod stock, and for studies of weld zone in ¼-in. plates. Although given in inch-pounds, results are said to approximate accuracy of results in foot-pounds obtained with the V-Notch test.

HOW the engineering of CENTRAL FOUNDRY *SAGINAW Power Steering*

The new steering gear housing based upon research by Central Foundry Division. Right: the new mold arrangement, with four castings per mold.



The original casting before re-designing. Note the protruding bosses and (left) the original mold arrangement with only 2 castings per mold.



and research facilities
DIVISION developed a better
Housing at lower cost

Here is an example of how Central Foundry research and engineering are helping reduce manufacturers' costs and at the same time providing improved castings. In this case, the malleable iron casting is the housing for the famous Saginaw Power steering assembly.

At the lower left is shown the original housing. This casting required 5 cores . . . 3 of them external. As the mold plan shows, only 2 castings per mold were possible.

Working together, Central Foundry and Saginaw Steering Gear engineers first attacked the problem of eliminating some of the costly cores. Thorough experimentation resulted in the elimination of the protruding bosses on the casting; a step which reduced the required number of cores to 2, and increased the number of castings per mold to 4. This is illustrated above (left).

By such techniques as radiography and stress analysis, experimental castings were carefully analyzed. Stress analysis indicated how and where section and wall thickness might be reduced. Radiography disclosed the degree of soundness of the test castings.

Based upon this new design came a production casting of improved quality and lower in weight by two pounds per casting. Correlated benefits were a reduction in machining area and greater yield-per-pound of iron.

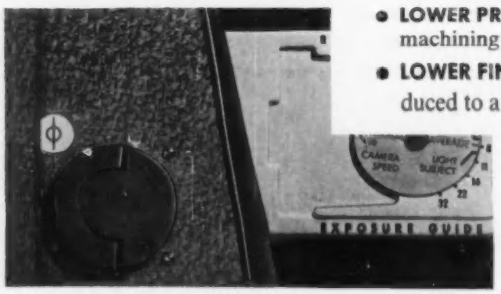
If you have a casting problem it will pay you to bring it to Central Foundry Division. Our modern research staff is ready to employ radiography, stress analysis, sonic testing, spectroanalysis, and our engineering knowledge and experience to help you improve your product and lower your costs.

Central Foundry Division produces high-quality grey iron, malleable iron, and ArmaSteel castings . . . in quantity, by either the sand or shell-mold process. The two books, "ARMA-STEEL" and "SHELL CASTING AT CENTRAL FOUNDRY" completely explain the materials, services, and techniques which are available to you through Central Foundry Division. Write today for your free copies of these valuable, fact-filled books.

CENTRAL FOUNDRY DIVISION

GENERAL MOTORS CORPORATION • SAGINAW, MICHIGAN • DEPT. 10
79

POWDER METALLURGY produces TRIPLE SAVINGS on REVERE CAMERA



The door knob and key are located on the opposite side of the case.

The pressing and sintering of BRASS AND NICKEL SILVER powders into small structural parts is an established technique for product engineering — quantity parts at high speed, high quality and low cost.

HERE IS AN EXAMPLE OF WHAT POWDER METALLURGY CAN DO FOR YOU

The camera crank hinge, door knob and key, shown above, are all made of metal powder for the REVERE 16mm, Turret Model 103 Motion Picture Camera. These three NICKEL SILVER sinterings create impressive production savings and provide handsome fittings for this popular movie camera. Working with the Chicago Powder Metal Products Company, Revere engineers found that by designing specifically for powder metallurgy, THREE important cost advantages could be gained:

- **LOWER MATERIAL COSTS.** The nickel silver sinterings are less expensive than comparable parts produced from extruded stainless steel, the usual material used for similar parts.
- **LOWER PRODUCTION COSTS.** Metal powder sinterings eliminate expensive machining of holes, undercuts and counterbore operations.
- **LOWER FINISHING AND ASSSEMBLY COSTS.** Secondary operations are reduced to a simple drilling of a connecting hole for joining the knob and key and take advantage of the ease with which nickel silver may be given a light satin finish.

If you are now making metal parts by conventional machining methods, it will pay you to investigate powder metallurgy. Let us send our free booklet, "Facts About Pressed Brass and Other Nonferrous Powder Parts". Perhaps a metal powder fabricator can help you.

THE NEW JERSEY ZINC COMPANY

160 FRONT STREET • NEW YORK 38, N.Y.

HORSE HEAD PRODUCTS

"We don't always know what we're doing . . ."

So says the president of a large Midwestern plant. "Every product we're making these days is twice as big—or half—as the jobs we've made before. So we make a lot of mistakes. The other day we threw away half the castings on one job. They were all defective . . . but they were twice as big as anything we'd ever made before. Somebody will have to pay for that mistake. . . ."

Other executives say the same thing in different words, because they have to make the next model half as large, or twice as accurate, or half as expensive. As somebody said a long time ago, "The price of progress is trouble." All of that price must be paid by somebody, with overhead added. And the price is rising everywhere because the pace of progress is so much faster.

A big chunk of this cost is, however, needless. It is incurred because of ignorance—the source of most mistakes.

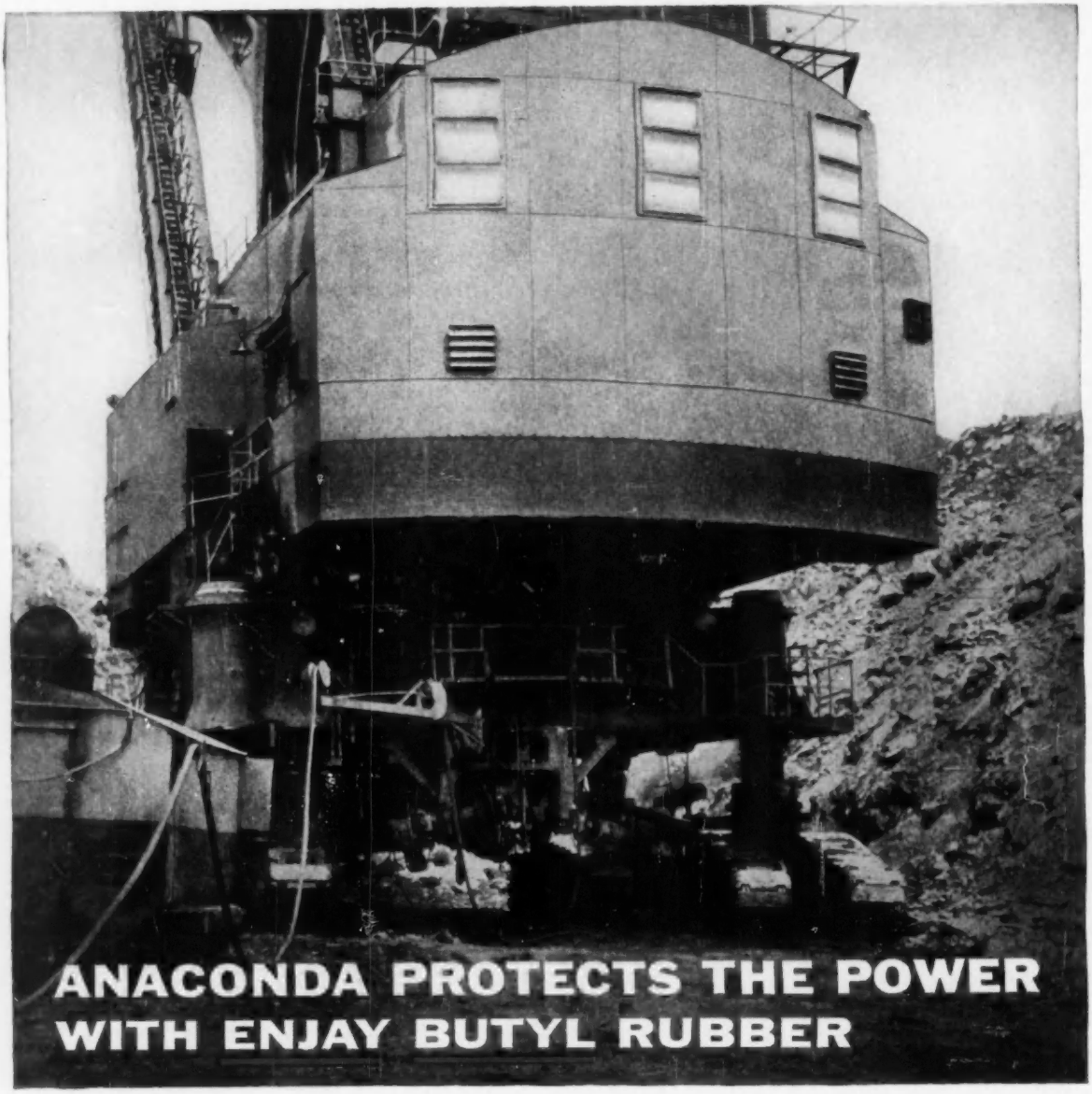
Obviously, some one must pioneer, and every extension of the frontiers takes its toll. **But the toll should not be paid repeatedly.**

The difficulty is in communication. Designer A passes a frontier and pays for his temerity. He solves his problems. He tells about the new frontier—in technical paper or magazine. But Designer B, who feels he's too busy to read or go to meetings, crosses the same frontier and repeats the mistake. The defense is always "no time." It should be "don't know."

The fault may not be Designer B's, but his boss'—or company policy. Has he time for meetings, for reading, for keeping up to date? What of the boss himself? What of the company? It's easier to blunder into trouble through ignorance than it is to learn. **But it's far more costly too—in time and in money.**

This new edition of *Product Engineering* makes one effort to meet the challenge. It is compact, easy to read, combines information previously available only from many sources. It saves your time by surveying and interpreting the field broadly, leaving to our Design Edition and technical papers the providing of exact detail. Our aim here is to interpret and analyze, and to be brief about it.

Thanks to the suggestions and help of many engineer readers, we think we know what we're doing in crossing this frontier. As a reader, however, you'll have an opinion of the success of the crossing, probably some suggestions on where we should go from here. By all means, let us have them. We want to make this service combine many, thus to save your reading time.



ANACONDA PROTECTS THE POWER WITH ENJAY BUTYL RUBBER

Talk about impact resistance! The 5-year-old Anaconda cable supplying this giant shovel with power was buried under thousands of tons of rock when a whole wall of the open pit mine caved in . . . *yet the cable continued to supply power!* This is one of the many Anaconda products featuring Enjay Butyl for *outstanding* performance.

Enjay Butyl is *unmatched* in its resistance to impact and abrasion, moisture and weathering, ozone and corona . . . properties that make it the world's outstanding rubber value.

Low in cost and immediately available in a grade tailor-made for *your* electrical application, Enjay Butyl is *the* rubber to boost performance and cut costs. For further information, and for expert technical assistance, contact the Enjay Company.

ENJAY BUTYL

Enjay Butyl is the world's greatest rubber value . . . the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

ENJAY *Pioneer in Petrochemicals*

ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.

Akron • Boston • Chicago • Detroit • Los Angeles • New Orleans • Tulsa

Design Problems Posed by High-energy Fuels

WASHINGTON—Much fanfare has attended the announcement of the new boron-based super fuels, high energy fuels, exotic fuels—all of the names are used interchangeably—that will power the plane of the not too distant future. For the moment, the primary advantage of the fuel is that it will increase by almost one-half the range of the present day plane. The NACA (Lewis Lab., Cleveland, Ohio) has been testing the fuel for two years. Olin-Mathieson Chemical Co., announced a contract award of $36-million for a facility for the production of high-energy fuels (H.E.F.) for the Air Force. First shipments produced have been sent to the Air Force, and Olin-Mathieson expects the HEF business to be a $1-billion industry within ten years.

But what effect will these new fuels have on aircraft engine design? It is well known that the super fuels burn hotter than the present JP-4, a jet fuel consisting of approximately 65% gasoline and 35% light petroleum distillate. The btu/lb value of JP-4 is 18,500 while that of the new boron based fuel is 25,000 minimum.

By questioning various companies in the jet engine design field, this much was learned:

Over-all effect of the design of the engines could be smaller if designed for H.E.F. alone, but the first goal is to have a dual-purpose engine capable of burning both H.E.F. and petroleum base fuels. H.E.F. will be used only for specific purposes, and not for routine training flights. The "specific purposes" in this case probably means afterburner use for occasional necessary bursts of speed. Such a system might well be installed in the B-58 Hustler (above).

Present indications are that H.E.F. will not be used before the turbine blades because the metallic products of combustion (B_2O_3, boric acid) will foul up the blades. Hence, the first consideration is for afterburner use, because the air velocity and smooth walls of the tail pipe are less likely to cause buildup of the boric acid.

This leads to the suggestion of a ramjet power plant—a simple engine consisting of a specially shaped pipe open at both ends with fuel injection in the middle. A ramjet does not work at all at low speeds, therefore the dual system is suggested again: a conventional jet engine to get the plane off the ground, as well as to land it, while at operational speeds (400 mph to supersonic), the ramjet takes over on H.E.F.

Such a system might have seen the light of day in the Republic F-103, just cancelled in the most recent of the Defense Dept. economy measures.

Weight of the engines may be less, and combustion chambers can be smaller when using H.E.F., and it may be simplified, but it is still uncertain. The reason for the shorter combustion chamber is the increased flame speed, needed for H.E.F.

The only solutions for the higher temperatures of the high-energy fuels are new metals or more air cooling. For that matter, the present jet fuel burns too hot for the metals now available. Several high-temperature metals are being considered for the H.E.F., including niobium and molybdenum with protective coatings. There is little interest now in ceramics except for protective coatings on vanes or blades.

The turbine rpm are not higher, there is no effect on the compressor pressure ratio because of the H.E.F.'s wider flamability, and the burning rate is not faster. H.E.F. weigh more than conventional fuels—how much is not known.

Because the products of combustion are corrosive, it presents a problem of getting better fuel atomization and complete combustion. This, plus a high temperature is necessary to prevent a buildup of clinkers around the spray nozzles. The ideal solution is to have B_2O_3 burn off as a gas but as this only will take place at about 4500 F, it is impossible for the present to consider that as an answer to the problem. To a minor degree, HEF present sealing problems.

Boron type fuels are suited to high altitude flights because of the excessive white smoke and powdered B_2O_3 as products of combustion. One spokesman said that it would be impossible to use the HEF for takeoff or landing because of this. This is another reason for the dual fuel system operation for planes using HEF.

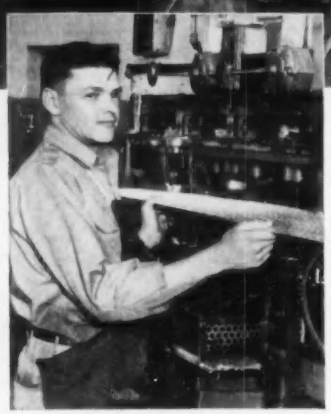
There are no comments on the cost of the new fuels, but it was indicated by the Pentagon that the cost of fuel is insignificant in the over-all picture.

Manufacturers of rocket engines also are considering the H.E.F. One company says that boron, beryllium or lithium derivatives may have merit if available cheap.

It adds up to this: the use of HEF is just around the corner—but by the military only; to take real advantage of the high heat content of the H.E.F. is impossible right now, for it would require higher, much higher temperature materials; completely utilizing this high temperature advantage would permit a smaller engine (about 15% smaller); thus a smaller package to get off the ground. The big advantage if used right now: more miles to the gallon, about 40% more.

automatic!

Feed, perforation, and cutoff equipment are all completely automatic, supplying single operator with prepared sheet for final forming.



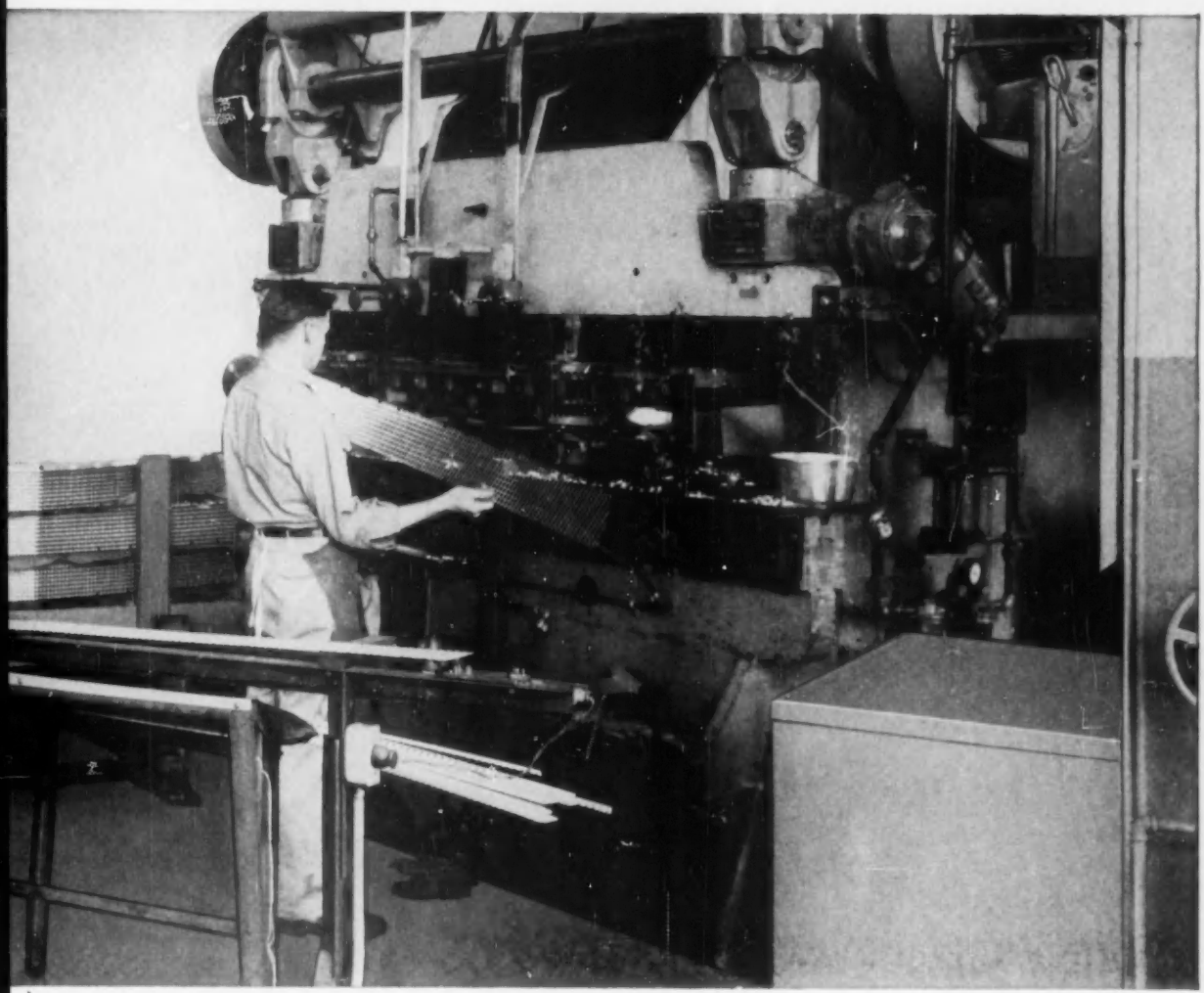
Karl Gauger, MIRRO stamping specialist, finds that, with more than half his job done automatically, he turns out *more* work with *less* work, and with a reject rate that's almost disappeared off the bottom of the graph!

modern

FOR YOUR ALUMINUM

What's done *automatically* cuts labor cost! Here, a *single* operator easily completes the entire fabrication process required for production of auto grilles or similar components, from continuous feed to final reblank.

We can apply automatic equipment like this to *your* aluminum component requirements, to give you high-speed, precision production at lowest cost. We



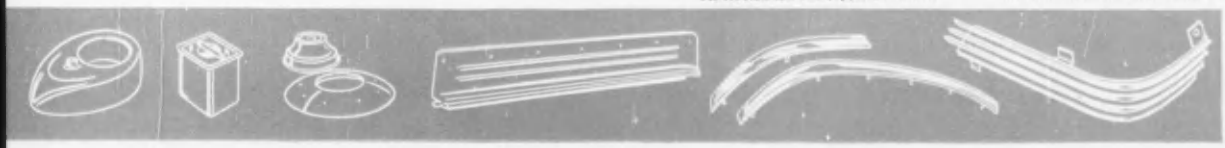
fabricating equipment

COMPONENTS...MEANS LOWER COST!

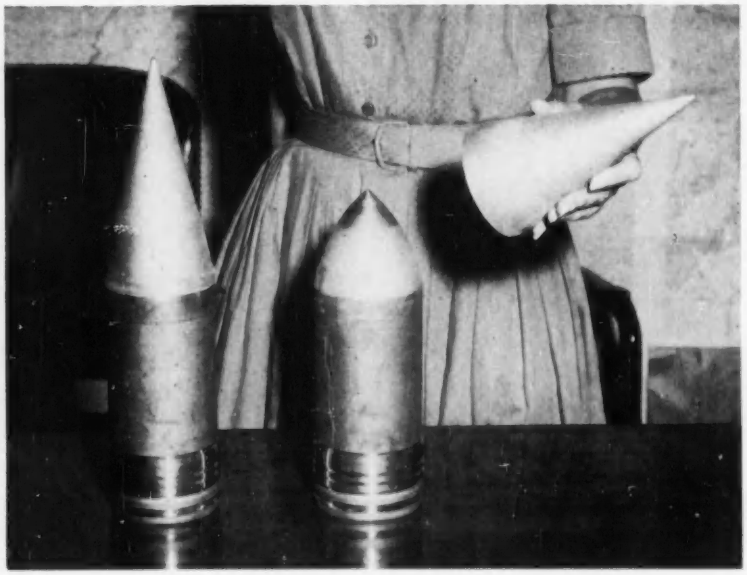
are also prepared to finish your components automatically, applying the chemical or mechanical finish best suited to your needs, whether for appearance or protection.

For complete details on the economy and accuracy of automatically produced and finished aluminum components, send us your inquiries. They will receive prompt, interested attention.

CONTRACT DIVISION
ALUMINUM GOODS MANUFACTURING COMPANY
MANITOWOC, WISCONSIN
FIFTH AVENUE BLDG., NEW YORK 10 • MERCHANDISE MART, CHICAGO 54



New Nose Is Glued Nose



RED LION, PA.–Nose contour of the projectile (center, right) is the best known for piercing armor plate, head-on or at an angle. Problem: how to improve range and accuracy of the 24-lb, 90-mm shell but retain the nose contour which could not be altered, because it is the best known for penetrating armor plate. Solution: The aluminum "windshield" (right)–a more pointy nose (left) that shatters on impact and lets the shell drive into tank or armored vehicle. Then to disintegrate after entry, with the resulting fragmentation and ricocheting inside the target area. New problem: how to attach it.

Answer was glue, a Bis-Phenol epoxy resin called C-14. The operation by Red Lion Cabinet Co., Red Lion, Penn., has successfully gone on a production basis under supervision of the Philadelphia Ordnance District. C-14 is made by Shell Oil Co., Ciba, and Chrysler Cycleweld Products Co., and already has been used in printed circuits, rudder and elevator sections for aircraft, boat hulls, and sport car bodies. Red Lion figures that any other method of attachment, like threading, would increase unit cost by 30%, and reduce penetrating performance of the shell.

Correct proportioning of adhesive and a catalyst is key to the method, with the measuring of the catalyst counted to the last drop.

After applying the adhesive, the 3¼ in.-dia., 7 in.-long aluminum cone is placed point down in a fixture and the heavy shell placed on top to effect a tight seal. While the resin cures quickly, its top strength is not reached for several days. Its tensile shear strength is about 3600 psi, and butt-shear strength 6000 psi. Its temperature range is from −65F to +200F.

Aluminum Subway Cars Have Inside Track in Toronto

TORONTO, ONT.–Members of the local Transit Commission are faced with a dilemma. They plan to buy 350 new subway cars for almost $30 million, but aren't sure whether to choose steel or aluminum.

The matter is of small consequence to subway motormen who find no difference in driving; makes even less difference to passengers–riding is equally comfortable in both types.

But the commissioners are concerned for reasons of cost. Here's the picture:

Two years ago when the Commission ordered 104 new cars, the supplying firm, Glouchester Railway Carriage & Wagon Co., suggested trying four all-aluminum cars. The commissioners agreed and for more than a year, a careful study has compared steel and aluminum cars in day-to-day operation.

The original cost of a steel car was $80,000; of an aluminum car, $84,000. However, subsequent tenders have increased the difference from $4,000 to $7,700.

Then again, this price differential is offset by maintenance costs; the aluminum car uses 3% less power, experiences fewer worn-out bearings and wheels, its brake shoes last 25% longer, and it requires no repainting. At this rate, an aluminum car costs $531 less per year to run.

If the cars are amortized over a 30-year period, and the money is borrowed at 5% interest, savings amount to $8,200 per car using the aluminum model–a $1,200-per-car savings over steel.

Glouchester officials point out that aluminum car bodies for the original order were cast from steel prototypes. It follows that if the order were increased from four to 350, a more advantageous strength-to-weight ratio could be obtained by using special extruded shapes possible with aluminum; hence, reducing cost per car by $1,200. Equipment mounting might also be adjusted to favor aluminum construction.

However, should there be an increase in the price of aluminum–there has already been one during recent months–without an appreciable jump in steel prices, the decision might be in favor of steel.

If the commissioners had to decide tomorrow, aluminum would most likely get the nod, but Allen Lamport, commission chairman, says, "We just haven't made up our minds." They will have to decide by Christmas.

The new cars will provide rolling stock for a new line being installed along Toronto's Bloor St., a thoroughfare that runs east-west.

Seat Belts (But Who Uses Them) Save Lives

WASHINGTON–Although at least 5,000 of the nation's 40,000 annual traffic fatalities could be prevented by auto seat belts, the American driving public has yet to be sold on them.

This was evidenced in the week of testimony by safety engineers and car manufacturers before House Interstate and Foreign Commerce Subcommittee.

A lone dissenting voice was raised by Andrew J. White, director of Motor Vehicle Research, Inc. He charged seat belts have limited value in current vehicle-interior designs, might even cause injury or death.

According to experts like John O. Moore, director of Automotive Crash Injury Research at Cornell University Medical School, there is still much to be learned about safety belts. For example, they aren't much help in high-speed accidents. He called for additional research before attempting to legislate them into cars. He said that a major problem is persuading people to use the belts–even after buying them.

Cornell's research project has built a file of 10,000 injury-producing accidents in 22 states involving 24,000 persons, of whom 700 use auto safety belts. These files show that in 81 accidents where belts were used, compared with another 81 accidents almost identical in nature where belts were not used, the belts reduced risk of injury and death by some 60%.

"This should answer the criticism that belts contribute to additional injury," Moore testified.

White had testified earlier that seat belts pose a danger to life and limb. In his opinion, "automobiles are now designed for cost, style, performance and reasonable life expectancy, but not in anticipation of accident-crash." He urged the automobile industry to make a fresh start in efforts to protect passengers from injury and death on the highways.

Ford Motor representatives reported their seat belt sales down from last year, and cited the need for a program to educate the public.

Rep. Kenneth Roberts (D., Ala.), subcommittee chairman, has introduced a bill requiring the Bureau of Standards to promulgate standards with which safety-belt manufacturers would have to comply. No action on the legislation is expected this year.

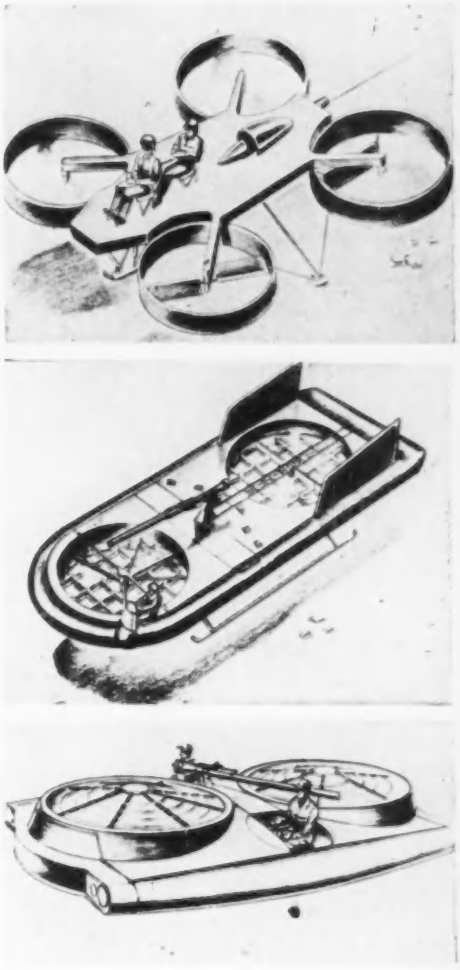
Army Contracts for Aerial Jeep

WASHINGTON–Seeking a general utility aircraft with the versatility of a ground jeep and maneuverability of a helicopter, Army has awarded three contracts to design, construct and test-fly what is best described as an aerial jeep.

Contract winners are Chrysler Corp., $661,000; Piasecki Helicopter Corp., $653,000; Aerophysics Development Corp., $388,000.

Prompted by recent developments in direct-lift devices utilizing the ducted propeller as well as improved power-plant designs, Army seeks a general-utility vehicle that can travel 50 mph, stay up several hours, and carry 1,000 lb of weapons or other equipment.

Small vehicle size would result from ducted propellers, the ducts increasing propeller efficiency. Army hopes to explore the behavior of ducted-propeller vehicles as well as determine the most promising control system. Different arrangements and configurations of ducted propellers and control systems will be investigated. If successful, the concept could lead to development of an aerial truck.



WHICH AERIAL JEEP
will it be? Artist's conceptions here are based on designs submitted by contract winners. The strange craft with four ducted propellers, instead of two, is envisioned by Aerophysics Development Corp.

Molybdenum Seamless Tubing By Cold Extrusion

RIVERSIDE, CAL.–Molybdenum seamless tubing by cold extrusion is being successfully produced here by Hunter Douglas Div. of the Bridgeport Brass Co., which has been cold-extruding aluminum alloy missile-motor tubes from aluminum alloy. The Atomic Energy Commission will use the new tubing.

Molybdenum tubing for specific applications has been considered in the diameter range of 1 to 6 in. Lengths over 5 ft are possible depending upon other dimensions, and walls from 0.030 to 0.125 in. have been produced. Surface finish ranges between 100-400 microinches, and concentricity of ID to OD is +0.003 or better.

Normally, molybdenum is hot worked at about 2000 F, but difficulties are caused by large quantities of exide at about 1300 F. Cold extrusion is reported to solve this problem, while giving precision tolerances after a few press operations.

Besides tubing, Hunter Douglas has made precision molybdenum parts with no draft by cold extrusion. Parts with configurations suitable for standard no-draft precision forgings also can be made with this technique.

the NEW AMPlivar splice plus new horizontal machine

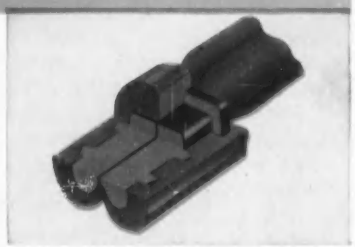
for identical, mass produced splices of enamel, poly-vinyl acetal and similarly coated wire

AMPlivar splices can be used on solid or stranded conductors, or combinations thereof.

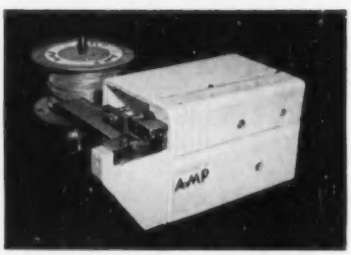
AMPlivar splices, with multiple ring stripping action, eliminate scraping, dissolving in solvents, burning, or other methods for removing insulation. Included among its many other features are:

- NO HEAT DAMAGE TO WIRE OR INSULATION—as often occurs in alternate methods of splicing.
- SMALL SIZE—scarcely larger than the wires themselves, but design-engineered to lock wire and connector into a high tensile strength splice.
- CORROSION RESISTANT—the joint is hermetically sealed during splicing.
- LOWER INSTALLED COSTS—eliminates soldering materials and equipment . . . requires less wire . . . reduces time required to make the splice.

Further information is available on request.



This cutaway of the AMPlivar splice shows how conductor material extrudes outwardly into serrations for added strength and electrical contact. The splice is as corrosion resistant as the wire itself.



IDEAL FOR ASSEMBLY LINE PRODUCTION . . . the AMP Horizontal Automachine uses AMPlivar splice connectors in strip form, for automatic splicing as fast as the operator can insert the wires.

AMP INCORPORATED AMP

General Office: 5513 Eisenhower Blvd., Harrisburg, Pa.

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada Ltd., Toronto, Canada • Aircraft-Marine Products (G.B.) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais, Seine, France • AMP—Holland N.V. 's-Hertogenbosch, Holland
Japanese Distributor: Oriental Terminal Products Co., Ltd., Tokyo, Japan

British Enter Fastest-Computer Race

A large-scale electronic digital computer, with a miniaturized "memory" that increases range and speed of problem solutions, is being introduced by Britain's Ferranti, Ltd. Known as the Mercury, it costs about $280,000 including installation and maintenance.

According to B. W. Pollard, head of Ferranti's Computer Dept., "this new computer puts Britain among the leaders in electronic computer manufacture. It is essentially for large-scale research work which could only be done by a few large and expensive computers in the U.S."

The Mercury can solve problems up to 50 times faster than any computer now being made in Western Europe, Pollard said. It will work on problems connected with guided-missile control and interception, atomic research, nuclear engineering, aircraft design, and long-range weather forecasting.

First export models are being shipped to Norway early this month. Others will be exported to France and Switzerland this year. Seven have been ordered for British use. Customers include London, Manchester, and Oxford Universities.

At this date it takes 12 months before delivery. Ferranti plans to produce at the rate of one Mercury every six weeks by Jan. 1.

Zinc Doldrums Blamed On Imports

WASHINGTON—Watch for a fight for higher tariffs on lead and zinc to crop up next year. Congress refused to increase tariffs this year.

The substitution of aluminum for zinc die casting in some markets, particularly in automobiles, has contributed to the unhealthy condition of the zinc industry in the US. But industry leaders diagnose the chief ailment to be the increasing percentage of imported zinc. In two years imports have risen from 40% of total zinc sold domestically to more than 60%.

Recent hearings before House Ways and Means Committee and Senate Finance Committee were highlighted by Administration proposals to levy taxes against imports on a sliding scale. Hatfield Chilton, Under-Secretary of the Department of Interior, argued that such a tax would split the production-cutback burden now borne by the US with foreign producers.

Economic Assistant Secretary Willis Armstrong of State Department testified that the proposed tax would offer more protection than the minimum excise the Tariff Commission could provide. ODM Chief Gordon Gray warned that government purchasing of zinc may end at the close of the fiscal year.

Opposing the proposed tax were Mexican exporters, zinc rollers and die casters. Represented by Oscar Chapman, ex-Secretary of the Interior, they argued that the tax would work a hardship on their country which relies heavily on its zinc exports.

Fabricators contended that the Administration proposal didn't include a long list of metals, such as brass, that contain lead and zinc. Opponents also testified the result would be world price fluctuations unfavorable to US industries.

Despite intensity of debate, no Congressional tax action is likely, if only because most committee members were convinced that the tax would open floodgates for appeals from other domestic industries. Any tax now must be provided by the Tariff Commission.

While the picture painted at the hearings was one of unhealthy oversupply, American Zinc Institute spokesmen predicted that 1957 would be among the top zinc-consumption years—about 950,000 tons. However, zinc prices have dropped steadily since late spring from 14 cents a lb to 10—this despite production cutbacks.

Small Business Gets A Boost

The product development problems of small business will get a three day going over at the President's Conference on Technical and Distribution Research, September 23-25.

Workshop sessions, a part of the conference agenda, will thrash out such practical problems as: how to get money for research and development, budgeting and cost control, how to recruit R & D personnel, coordination of R & D with production, sales etc.

Roughly 1000 representatives of small business, and leaders from the fields of technology, education research have been invited to participate.

Doubts Settle on Deal Between Curtiss-Wright, Daimler-Benz

WOODRIDGE, N. J.—It looked solid but reports now are that the complex deal between Curtiss-Wright and Daimler-Benz (Apr. 57, p. 10) stands a good chance of falling apart at the seams.

It calls for the Germans to give Studebaker-Packard (through Curtiss-Wright) an exclusive distributorship to the complete line of Mercedes-Benz cars. In return, Mercedes-Benz would make aircraft engines for Curtiss-Wright. Also, S-P would ultimately manufacture or assemble M-B marine and diesel engines, and a tractor-truck called Unimog and have access to M-B styling and engineering design aids.

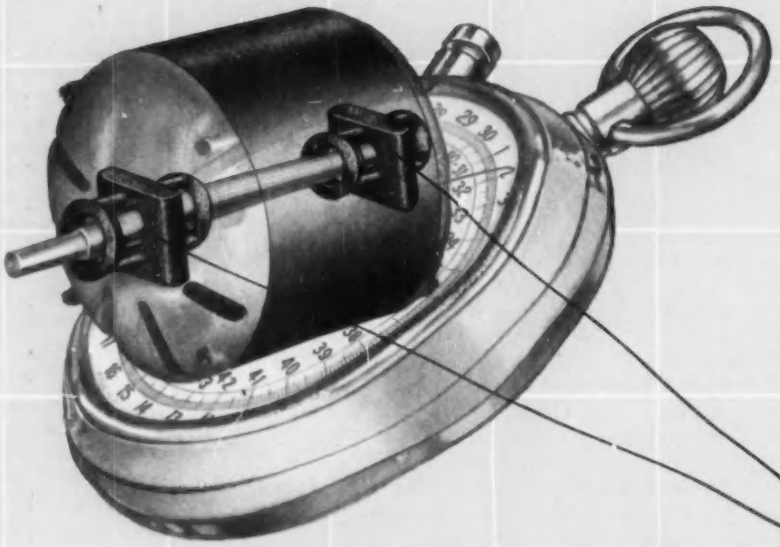
Reasons given for the falling out are numerous. One: C-W could not get permission from the aircraft engine licensor allowing M-B to make it. Another: Instead of getting several thousand distributors for the M-B line, as promised, only several hundred have been obtained. The story is many S-P distributors refuse to go to the trouble of setting up sales and service facilities for the more expensive German cars, even though recent sales figures show S-P at a low point. Just plain inability to get along with each other is another reason. Curtiss-Wright apparently has been dictating policy too much to suit Daimler-Benz, who would like to be consulted more often. This is indicated by the recent resignation of Dr. Witsky, M-B's chief engineer in this country, at the Utica Bend plant in Michigan—also the sudden, unpublicized visit by Dr. Fritz Koenecke, M-B's president, to Curtiss-Wright several weeks ago, presumably to mend some fences.

Although the future of all other aspects of the deal are uncertain, the part pertaining to S-P distributorship of M-B cars will stand up. This the German company really needs.

Another agreement with an uncertain future is that between S-P and C-W, especially if the big Air Force jet contract recently given to S-P's Utica Bend Division falls through. This is not impossible, if the hot cross-examination given C-W president Roy Hurley by a Congressional Committee a few weeks ago is any indication.

in just 2 seconds...

this motor completely "wicked" and lubricated... automatically!



PERMAWICK*

MAKES THIS REVOLUTIONARY PROCESS POSSIBLE!

PERMAWICK is the world's first and only lubricant that *combines* both wicking material and oil in a single fluid form. PERMAWICK is automatically injected under pressure . . . in just 2 seconds . . . and molds itself to fill and take the form of any size or shape bearing cavity. This remarkable achievement now makes possible full automation of sleeve bearing assemblies . . . eliminating all felt parts and costly hand insertions of these parts. In motors, PERMAWICK also eliminates vertical scavenger felts . . . permitting all angle mountings without additional components. PERMAWICK (85.7% oil) means twice the lubricant in the same space . . . greatly increasing product life and efficiency.

PERMAWICK has been conclusively proved in the laboratory and in the field, on hundreds of thousands of products now in actual use. Learn how you can utilize revolutionary PERMAWICK in *your* products and production process. *Send today for complete descriptive brochure and free sample.*

Fluidwick COMPANY

5319 EAST OUTER DRIVE
DETROIT 34, MICHIGAN

Colored, Integral Decoration for Multiple-curved Plastic

The first successful production application of integral overlay decoration to a compound-curved melamine plastic surface is this colorful beer-tap handle. The 13-in handle has been more than three years in the making by Schlitz, Hammer Bros., and the Chicago Molded Products Corp., Chicago.

A decorated pattern section, gray-green color band, and white collar comprise the three separate plastic components. Parts are molded of melamine, to resist chipping as well as staining and discoloration.

Designed around the brand name, a five-color Bavarian scene is impregnated on opposite sides of the handle. This is done as part of the molding process by fusing together two similarly decorated melamine overlays. Excluding the dinnerware field, the tap handle is the first product to use this technique on compound-curved surfaces, and is the first production use of melamine foil overlay patterns.

Some of the design problems were producing integrally decorated thermoset parts, and maintaining proper balance to provide correct handle leverage.

Chicago Molded's decorated section is produced on a single-cavity die run on a 178-ton transfer press. Two oblong preforms are preheated and placed in the press for each shot. Liquid melamine into the closed die is allowed to precure until it will retain its shape without the mold. Next, the press opens to permit insertions of melamine overlays. The printed overlay is fused to the surface of the handle, with the design protected by a layer of transparent melamine.

With the foil-overlay method, the door may be opened for similar production of integrally decorated items such as clock cases, radio cabinets, door knobs, cigarette lighters, organ-stop keys and electric shaver housings.

Latest in Boomerangs—The Engineers Shortage

Dr. Alan T. Waterman, director of the National Science Foundation, ha expressed grave concern over the National Bureau of Economic Research study published last summer which maintains there is not now and never has been a shortage of engineers.

Ironically, *The Demand and Supply of Scientific Personnel*, made by economists David M. Blank and George J. Stigler, was carried out at the request of Dr. Waterman's own NSF. Waterman wanted a report that would develop and appraise techniques to measure the supply and demand for engineers. NSF had not expected the bureau to make an appraisal of the current situation.

Waterman made his views known in a letter to the Interdepartmental Committee on Scientific Research and Development of which most government agencies are members. He felt clarification of the NSF stand was necessary "lest an erroneous impression be created, on the basis of insufficient evidence, that there is no shortage of engineers—a premise which in my judgment would be injurious to the best economic defense interests of the U. S. You will recall that just such false impression was created in 1950 by the pessimistic forecast of future employment demands for engineers. This forecast tended to depress engineering enrollments, the effect of which is still being felt."

Because of its timing and the fact that the National Bureau is a research organization with a well-rooted reputation for competence and integrity, the book which might otherwise have passed as a dreary exercise in statistical analysis takes on general interest. Waterman's fears are shared by others. Dr. Howard Meyerhoff of the Scientific Manpower Commission says he has been in contact with some 20 to 25 companies since the study appeared. All are having trouble hiring engineers, and fear the report will scare off college students coming along.

The book's authors base their contention on a fundamental economic principle holding that when there is a shortage of any commodity (in this

What Helps You Get Ahead? . . . Not What You Think

SAN FRANCISCO—Startling differences between what engineers assume to be prime qualifications for research and management—and what they really are—were reported here in two papers presented at the Western Electronic Show and Convention (WESCON).

Rate of salary growth shows no significant correlation with measured experimental ability, analytical ability, initiative, industry, originality, general knowledge, sincerity, appearance, personality, or leadership.

There is no relationship between undergraduate class standing or college ratings and salaries. Age, quality of references, rating of school from which graduated, extra-curricular activities at college, number of dependents, particular college attended, marital status and similar factors normally considered important during employment consideration are not statistically significant in determining entrance rating or salary growth.

What is significant? In order of importance: level of degree, papers published, number of honor societies, major at college, number of patents, number of fellowships. Perhaps supervisors will now adopt a broader and wiser attitude in considering engineers for employment as a result of this detailed statistical study of hundreds of engineers and scientists by Robert A. Martin and James Pachares, both of Hughes Research & Development Laboratories.

WHAT MAKES A GOOD LEADER?

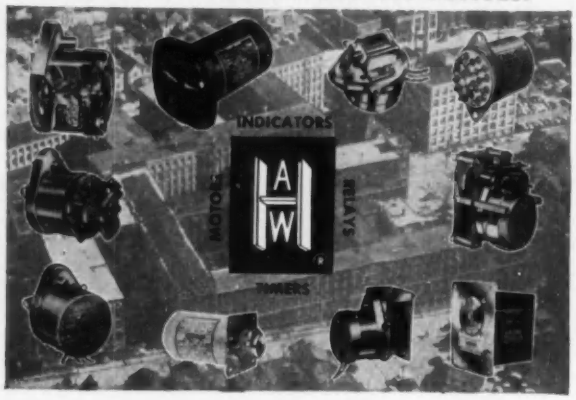
The ability to get along with people, to delegate responsibility, to make decisions, to establish and maintain direction. Transition to supervision is the difficult time, says H. M. Elliott of RCA. The new supervisor must be careful to avoid:

1) The attempt to do everything.
2) The tendency to delegate responsibility without authority.
3) Arbitrary setting of time limits rather than by discussion.
4) Disciplining staff members before others.
5) Lack of tact, or conversely . . .
6) The tendency to regard himself as "one of the boys"—not so.
7) The tendency to interfere in an engineer's work to "get on with the job."
8) The opposite of interference—laxity.

The supervisor must be able to sense when a project is slipping, and let it slip just enough so that when he steps in to change assignments the engineers realize the need. Further, the supervisor now has a new identity with the group. Within the group he may criticize, he may reprimand. Outside the group he is the only one responsible for the group's action.

one source for all timers!

the
A. W. HAYDON COMPANY *offers a*
COMPLETE LINE *of* **STANDARD** *and* **CUSTOM DESIGNED TIMING MOTORS** *and* **DEVICES!**



for military and industrial applications. Illustrated are some of these units . . . any can be modified to meet your specific requirements if the basic design is not adequate.

Shown below is the new catalog of the A. W. Haydon Company describing all of the basic types of units available and many of the "specials". Included in this 25-page catalog are 60 photographs of timers, 30 dimensional drawings, and 50 charts and diagrams. This complete catalog will be supplied on request.

Long a pioneer in the timing field, The A. W. Haydon Company is prepared to assist you in solving your timing and control problems. When a solution to your problem has been reached, The A. W. Haydon Company is prepared to follow through with production geared to meet your requirements whether a basic timing unit or a highly specialized device is required.

the **A. W. HAYDON COMPANY**
221 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electro-Mechanical Timing Devices

(Continued from page 33)

case, engineers) the price paid for it (in this case, salaries) should rise in relation to other prices (salaries of other professional workers and wage earners). The principle, of course, holds only in a free market where engineers can quickly move from job to job and where there are no artificial restraints to salary fluctuations. The authors assume this is the case.

Armed with a pot pouri of salary statistics and a guiding principle, authors Blank and Stigler discover that engineering salaries have dropped in relation to salaries of other professional workers and even of the general labor force since 1929, except for a brief period after the start of the Korean War. And since a shortage of engineers does not exist according to this type of analysis, the authors imply that an increase in the number of engineers will only serve to further erode their income position.

Objections to these sweeping conclusions are raised on the basis of both the age and quality of the statistics, and the underlying assumption of a free market. Salary surveys of recent vintage (the latest figures in the National Bureau analysis covered 1954) indicate engineering salaries have actually risen faster than other salaries in the past few years. Salary surveys by the Engineers Joint Council show that engineers experienced a 25% average increase in salary during the interval between surveys of 1953 and 1956. US Department of Commerce figures, on the other hand, indicate incomes of all wage and salary employees rose 12% during the same period. Calculations by the McGraw-Hill Department of Economics show incomes of physicians rose about 14% between 1953-6, and lawyers about 19%.

The underlying assumption that engineering salaries respond immediately to changes in supply is considered unrealistic by many critics. Many engineers, particularly civil engineers, are employed by the Government and a change in their salary schedules requires legislative action. Some are employed by aircraft companies that abide by anti-pirating agreements. In fact, most engineering salaries fit within an established salary framework. They change in response to supply, but the change almost inevitably requires administrative action that lags behind recognition of the fact of a shortage.

FACTS ABOUT MODERN

PORCELAIN ENAMEL

—a finish that offers designers many useful and unique properties

Briefly, Porcelain Enamel is literally a glass coating which is formed by fusing pulverized inorganic materials onto a metal base. It is applied to the metal in liquid form either by spraying or dipping, dried to remove water, and fired in a furnace at temperatures ranging from 1100°F and up. During this operation this mineral coating actually melts and fuses into the surface of the metal in an inseparable bond. Upon cooling it becomes a glass-hard, permanent finish, known as Porcelain Enamel—a finish that offers industrial designers and engineers many advantages.

reduces costs

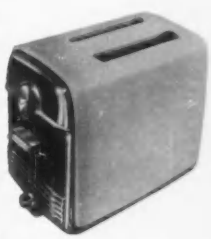
In first cost, Porcelain Enamel is inexpensive for most applications—but its *major* economy lies in its lifetime service. Literally hundreds of cases exist where Porcelain Enamel has extended the service life of industrial, commercial and consumer products so long that repair and replacement costs are now either negligible or have been eliminated altogether.

versatility aids designers

Designers use Porcelain Enamel freely because it can be applied over any shape, and offers so many proven advantages for both industrial and commercial applications. Among these are resistance to heat, corrosion, abrasion and acids, high reflectance value, high emissivity, a smooth, sanitary, non-porous surface, high strength and hardness, freedom from maintenance. While it is true that some other finishes offer some of these characteristics, only Porcelain Enamel provides all of them and there are many applications where various combinations of these characteristics are desired or required. Often special formulas are developed by Porcelain Enameling companies to solve specific problems.

color helps sales

Color in products of all types from home appliances to building panels has been influential in setting sales records. Porcelain Enamel offers matchless opportunities for designing color into many products. It is available in a rainbow of hues, all of which are non-fading and will not stain or peel. This is true because Porcelain Enamel's color is an integral part of the finish.



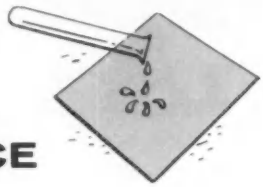
non-absorptive

The smooth, hard, non-porous character of Porcelain Enamel provides no foothold for dust, dirt, odoriferous residues or other enemies to sanitary cleanliness. All soil is on the surface where it can be easily and completely removed. Porcelain Enamel, like glass, has outstanding radioactive decontamination characteristics.

PORCELAIN ENAMEL INSTITUTE
Associations Building, 1145 Nineteenth St. N.W. • Washington, D.C.

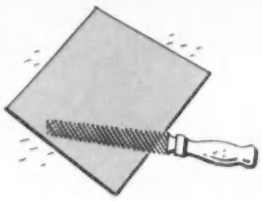
Turn the page for information on engineering properties

Properties and Characteristics of PORCELAIN ENAMEL



CHEMICAL RESISTANCE

Porcelain Enamel's resistance to attack by alcohol, chemicals, gases, water and other corrosives is one of its most useful characteristics. Grades designated as "acid resisting" are immune to most acids, including sulphuric and nitric. All grades resist organic solvents, and mild alkalies with a pH of 7 to 10. Companies in pulp and paper, food, chemical, dye and petroleum industries use Porcelain Enameled parts like strainer baskets, tanks, liners, convectors. The Hot Water Storage Tank with "glass lining", (a term sometimes applied to Porcelain Enamel), is a good example of where it is used because of its long lasting resistance to chemical deterioration.



ABRASION RESISTANCE

The surface of Porcelain Enamel varies from 3½ to 6 on Moh's scale and to a corresponding range of about 149 to 560 in Knoop hardness numbers. The Sward rocker hardness, where plate glass equals 100, shows the hardness of Porcelain Enamel as 100. This glass-like surface makes Porcelain Enamel one of the hardest finishes known for resisting abrasion. This, combined with its low coefficient of friction, makes it particularly adaptable for applications requiring a smooth surface that will not pit, scratch or wear. Package chutes, grain elevator spouts, escalator risers, screw conveyors are examples of the use made of Porcelain Enamel's hard, smooth, durable surface.

Auto tail pipe extension

Porcelain Enameled automobile mufflers and tail pipe extensions withstand condensation from exhaust vapors, salt solutions from de-icing chemicals, mineral oils and other corrosive atmospheric conditions.

Strainer baskets

Live steam, chemical reactions and temperature change have no detrimental effect on these strainer baskets used in styrene production.

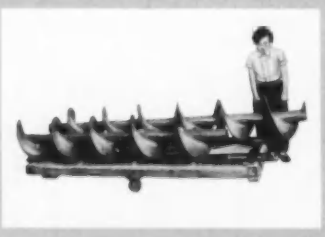
Resists combined attacks

By sealing fine nickel wire between two coats of Porcelain Enamel, this temperature-sensitive device is made impervious to moisture penetration, high temperature and atmospheric corrosion.

Switch Plate

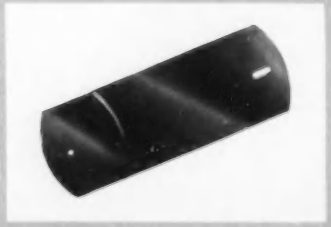
Porcelain Enameling this motor switch plate solved wearing action from felt wheels that was a constant problem when stainless steel, case hardened steel, chrome plate and other materials were used.

Conveyor Screws

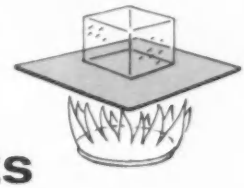


Its low coefficient of friction and excellent corrosion resistance recommended Porcelain Enamel as the finish for these conveyor screws handling coal and chemicals.

Shoe Plate

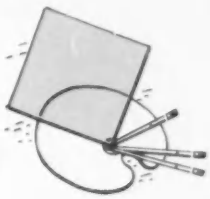


This "shoe plate" for a continuous enameling furnace is Porcelain Enameled. It is continuously subjected to abrasion and high temperatures.



THERMAL PROPERTIES

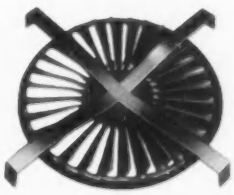
Porcelain Enamel is flame-proof, resistant to temperatures as high as 1500°F, has a high thermal emissivity value, and thermal shock resistance that withstands sudden temperature drops of as much as 350°F. Ceramic coatings—special types of Porcelain Enamels designed for temperatures as high as 2000°F—have been developed to meet individual requirements. Cold and sub-freezing temperatures have no harmful effect. Lantern parts, exhaust components, combustion chambers, ranges and barbecue equipment illustrate applications where Porcelain Enamel is used because of its heat, flame and thermal shock resistance.



COLOR AND TEXTURE

Porcelain Enamel is available in three main classifications of textures—*glossy*, which offers minimum friction, ease of cleaning, highest reflectance and greatest sheen, *semi-matte or satin* finish, for many decorative applications, and *full-matte* for use where a little "tooth" is desired, such as for chalkboards. White, plain colors in any shade, or patterned combinations can be obtained in Porcelain Enamel. All of these variations are an integral part of the finish, inherent in the inorganic materials of which it is composed, and fired-in at high temperature. That is why Porcelain Enamel serves a lifetime without peeling, aging or changing.

Flame Spreader

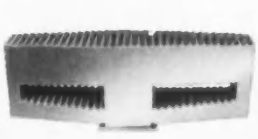


This odd shaped part is a flame spreader. A Porcelain Enamel or ceramic coating not only provides thermal protection for the metal but its excellent heat characteristics can improve thermal efficiency.

Jet Afterburners

These jet plane afterburners are subject to extremely high temperatures. Specially developed Porcelain Enamel provides the required heat resistance.

Heat Exchanger

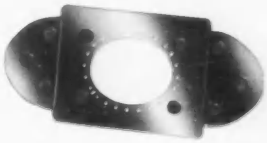


Flames and combustion gases introduced into the opening of this heat exchanger produce rapid thermal changes that the Porcelain Enamel coating withstands without damage.

Auto Brake Drum

The bright red color of this Porcelain Enameled automobile brake drum will remain unchanged even though heat generated in braking might attain several hundred degrees.

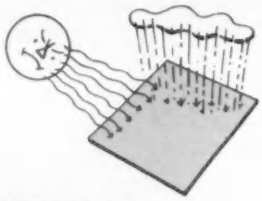
Stove Pipe Shield



This stove pipe "tent shield" was specified in olive-drab with full matte texture, to blend with surroundings and prevent light reflection. In addition, the metal needed to be protected against corrosion, and the part needed to be thermally stable and mechanically strong. Porcelain Enamel provided the answer.

Modern Toaster

Another excellent example of how several of the multiple advantages of Porcelain Enamel are imparted to one product. Here, color and texture are primary advantages; resistance to scratching, heat and fading are "bonus" advantages.



CORROSION AND WEATHERING

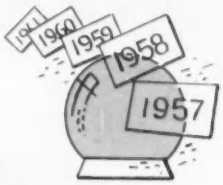
Where dependable, long-lasting resistance to corrosion is imperative, Porcelain Enamel has proven extremely practical. Many types of industries have adopted Porcelain Enameled components for such equipment as processing vessels, pumps, furnaces, and illuminating units because it provides the protection that so drastically reduces maintenance and replacement costs or eliminates them entirely. Signs, architectural Porcelain Enamel panels, building trim, gasoline pump crowns and awnings are a few of many outdoor applications for Porcelain Enamel where its lifetime resistance to the elements and corrosive conditions in general have earned it a high reputation.

Dust and Fumes

A machinery identification sign will withstand corrosive fumes and abrasive dust, even in a foundry if it is Porcelain Enameled.

Chimney Cap

This is a section of a chimney cap, protected against the corrosive effect of weathering and fumes by a Porcelain Enamel coating.



RECENT AND FUTURE TRENDS

Because the process of Porcelain Enameling has been known so long and commercially developed over so many years, its dependability for many types of uses, as suggested in this review of its properties, can be predicted with considerable accuracy. Still, enamelers across the country are constantly engaged in research and experimentation for faster production methods at lower cost, for improved enamels on known applications, and for new and broader use of Porcelain Enamel in all fields. Such endeavors have resulted in vast strides in many fields since World War II. Currently, Porcelain Enameled aluminum and stainless steel are attracting the attention of architects and designers.

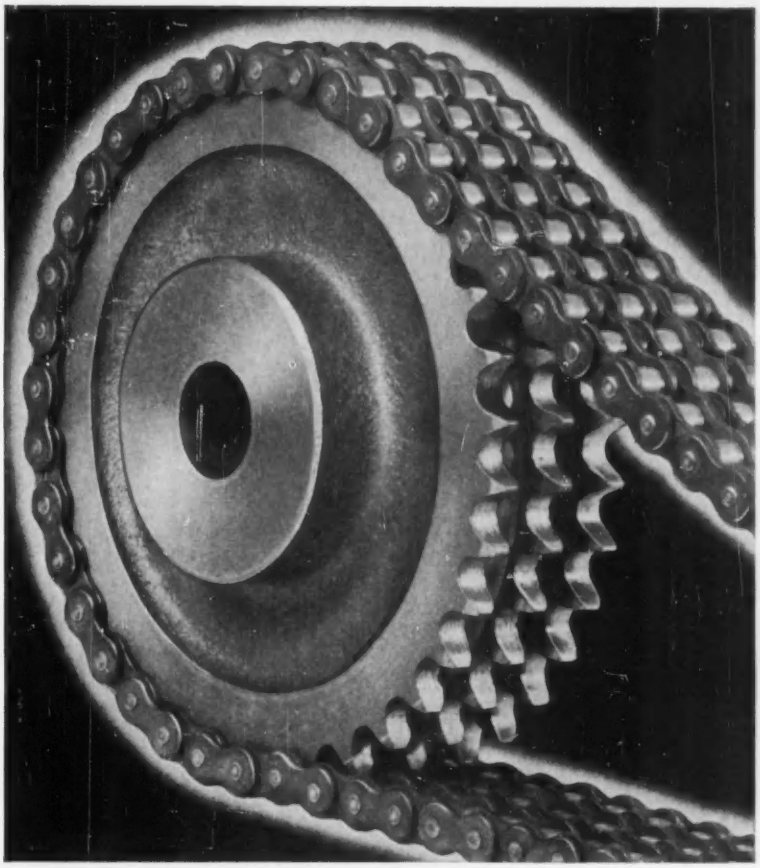
Appearance innovations in Porcelain Enamel are continuously being made. Porcelain Enamelers now produce metallic finishes such as gold- and metallic-appearing finishes such as copper, bronze and gunmetal. The use of color is considerably widened. Thinner coatings, requiring less material, fewer production steps and with improved mechanical properties are currently under investigation. Low-firing enamels with the advantages of lower fuel, tooling and maintenance costs promise to extend the use of Porcelain Enamel to applications for which it has not previously been used.

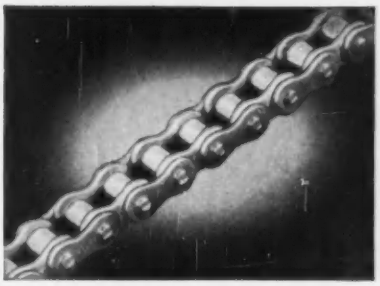
Porcelain Enamel deserves serious consideration on the part of any product designer because its use can solve so many problems where a finish of beauty or durability under severe service conditions, or *both*, is a necessity.

For further information write

PORCELAIN ENAMEL INSTITUTE

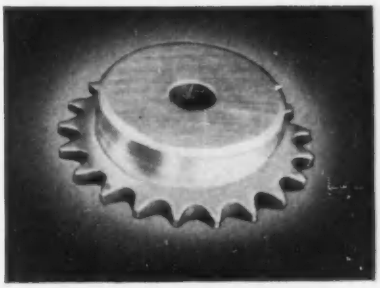
Associations Building • 1145 Nineteenth St. N.W. • Washington, D.C.





ATLAS *Electrolized* ROLLER CHAIN

Available in all sizes for tiny timers to big, tough multiple chain drives. Regular or heavy duty . . . standard or extended pitch . . . steel, stainless steel, bronze or the new exclusive Atlas Electrolized Chain.



ATLAS *Balanced* SPROCKETS

Precision made to exact chain fit. Available in all sizes 3/8" pitch to 2" pitch . . . steel, stainless steel, bronze or Atlas Electrolized for longer life.

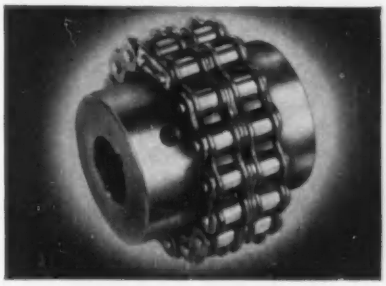
TESTS PROVE ATLAS *Electrolized* DRIVE CUTS COSTS 100%

LESS FRICTION . . . HIGHER TENSILE . . . CORROSION RESISTANT

Out of the modern laboratories of Atlas come results on grueling torture-tests of Atlas Electrolized Roller Chain. Proof that when used on power drives it outlasts others by as much as 100% . . . possesses a higher tensile strength than other corrosion resistant chain . . . has a lower coefficient of friction to reduce power losses.

Atlas Roller Chain, Sprockets and Flexible Couplings are precision matched to operate as a power team for peak efficiency. They are made to run quieter, last longer and require less maintenance. They are a *power team* to provide higher efficiency and longer life on every type of installation.

ATLAS CHAIN AND MANUFACTURING CO., P.O. Box 708, West Pittston, Penna.



ATLAS FLEXIBLE COUPLINGS

Quiet running, ruggedly built for every drive. Available from stock—bore 7/16" to 3 5/16" . . . O.D. up to 7 5/16".

GET THE FACTS

Please send data on how to increase efficiency with

POWER SAVING TEAM

NAME _____ TITLE _____

COMPANY _____

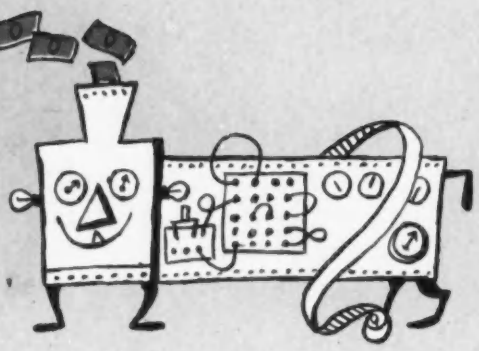
ADDRESS _____ STATE _____

CITY _____

ATLAS

POWER TRANSMISSION PRODUCTS

are COMPUTERS oversold?



Consultants are having second thoughts. Do you agree?

Is management being pressured into EDPM—Electronic Data Processing Machines—by promise and threat, by advice of so-called staff "specialists" and dictates of fashion?

Management is told that EDPM will "have impact on management effectiveness," that "this is the computer age" and "the electronic frontier," that "EDPM will clearly separate the men from the boys in commercial and industrial management."

Is this sophisticated sales talk panicking management into making premature or unwise commitments in the electronics field?

Ironically, some companies actually force themselves to join the parade. They hire a Manager of Electronic Applications or a Director of Electronic Program. First, he makes a study—EDPM or not. And he recommends: Buy. If he decided anti-EDPM, the newly hired man would be recommending his own dismissal. EDPM is also sold to management by staff personnel intrigued and infatuated by what they were signed to investigate.

No one likes to be old-fashioned. Companies not using EDPM are often regarded as ultra-conservative by stockholders and members of the board of directors.

Perhaps its psychological value makes a computer a good investment—and perhaps some company heads regard it as just that. But this psychological value comes at high cost. Though stockholders tend to be favorably impressed by five- and six-figure numbers, computers, especially if over-large, can waste space and needlessly complicate solution of simple problems.

And note that an EDPM bought for engineering may also be used for accounting and clerical work—but a machine designed for clerical work may not have the range or memory storage for engineering.

FOR ENGINEERS . . . YES

EDPM is applicable to many phases of design, research and development. Result: Base for engineering decision broadens; research and development studies speed up; procedures and products are standardized. Best of all, a net saving in dollars comes from possible improvement in products and methods. But don't expect wonders overnight; savings may not show for five to 10 years (see chart).

And remember: Personnel must be trained. Either a company course must be instituted or outside courses considered. These should not be superficial. Stevens Institute of Technology and other colleges and universities have started courses and graduate programs in the design, selection, and application of computers. The Stevens course for full-time industry employees takes two nights a week for three years.

NON-ENGINEERS . . . MAYBE

There are only three justifications for using EDPM in the field of management—as differentiated from engineering. These are:

1. To cut clerical costs.
2. To give better, faster management-control information.
3. To facilitate the application of mathematical-analysis techniques for solving business problems.

Clerical costs. Here, net profits range from fair to poor. General-purpose computers are not yet designed specifically for processing business data, although improvements have been introduced in recent years. Present high-speed digital machines are still only refinements of earlier scientific units—designed during and after World War II to meet entirely different data-handling requirements.

But this is not the major reason for indifferent results. Management must guard against some basic mistakes that lure companies into uneconomic electronic installations.

• Installation expense, machine-preparation time and one-time-problem costs may go way over first estimates. Few management men appreciate how detailed a single computer program must be. For its first computer

run, one company used a payroll procedure covering 8000 employees–some on a complicated incentive system. The program required 200,000 separate machine instructions and took 20 man-years to complete.

• Recurring operating costs of an EDPM setup are easily underestimated. Any proposed system is highly idealized–seldom reflects the exceptions. The extent of machine utilization will be unrealistic if maintenance downtime is overlooked or peak-valley variations in the work loa' neglected.

• And don't credit all clerical savings to the computer. It is possible many would have resulted anyway –simply from the critical review given your existing method.

Management Control. Undeniably, EDPM is the speed champ in information output, but many managers now wonder–can this information be assimilated and used intelligently at the speed it is generated? Specifically, here are the questions that need answering:

Are we losing sight of the greater need to sharpen our skills in selecting information of real worth?

Is management being buried under so much information that it will have to be rescued some day, from its own accountants and statisticians?

With all the additional information available, is top management in danger of undermining decentralization and the carefully planned delegation of responsibility?

Will this short-term focus divert management from its primary job of long-range planning?

Management is already drowning in a flood of reports, opinions and red tape. It's time for a careful determination of what information is really needed to plan and control the business profitably. Done well, this should result in less . . . but better . . . information.

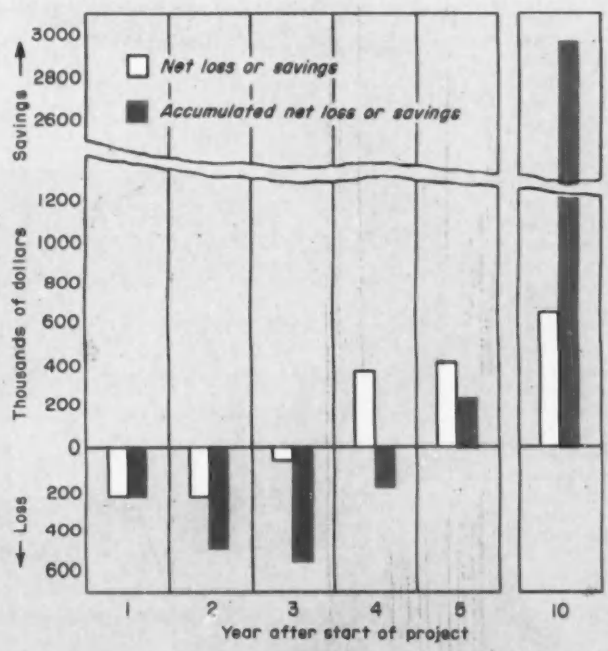
A mere list of the kinds of additional information the computer will give is next to useless. Demand that the EDPM salesman spell out how the information can be used and what specific types of decisions and actions it will affect. What would be the cost and time required to get this information by present methods? How much faster will EDPM work and how much will this speed cost?

Operations Research. EDPM teams well with accounting, clerical and management uses in the application of advanced mathematical techniques to the solution of business problems. As yet, relatively few companies with EDPM are using them on Operations Research. Nevertheless, this is a ripe field. O-R can optimize production sales ratios by considering variations in labor force, overtime, inventory and back orders. It can lower warehousing and freight costs; offer economies in equipment-maintenance programs by balancing failure cost against the cost of maintenance; make best use of production facilities by determination of the optimum product-mix and running time. But only a small percentage of O-R problems require electronic computers for their solution. Most can be handled with paper and pencil, slide rules and hand-operated desk calculators.

Admittedly, large-scale computers have enlarged the O-R field. "Impossible" calculations are now feasible. This broadens the application of O-R, but even here, EDPM is not a *must*. You can rent unit time to handle the more difficult problems, then use simple calculating methods to re-optimize the problem in light of the latest company conditions.

SO, BEFORE YOU BUY, . .

Undeniably, EDPM is a useful and valuable tool but it must be purchased intelligently and used constructively. It is no sure guide to better business, higher profits, fewer workers, more leisure. Is it justifiable? Yes, if it can pass the same tests that are applied to any important company purchase.



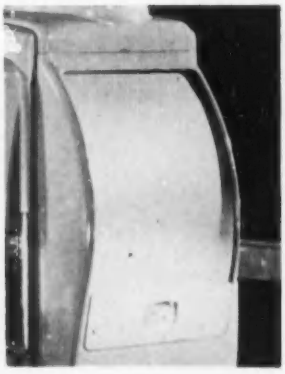
ASME paper 57-MGT-2

Integrated pedestal replaces classic tree shape of dental instrument unit. Switch under tray opens and advances instrument rack, exposing fluorescent panel for viewing radiographs. Spherical mount for drilling engine and arm provides freer tilting and rotating. Long, gentle curve of chair's footrest positions patient more comfortably, whether short or tall. Designed for Ritter Co., Inc., by Walter D. Teague Associates, New York.

A. Patient sees only a retractable curved panel while being seated, instead of a worrisome array of instruments.

B. Regrouping of components of X-ray head made possible a simple housing that could be gimbal-mounted.

C. X-ray controls and power unit are united in this chest-level case, which can be mounted on wall or floor pedestal.

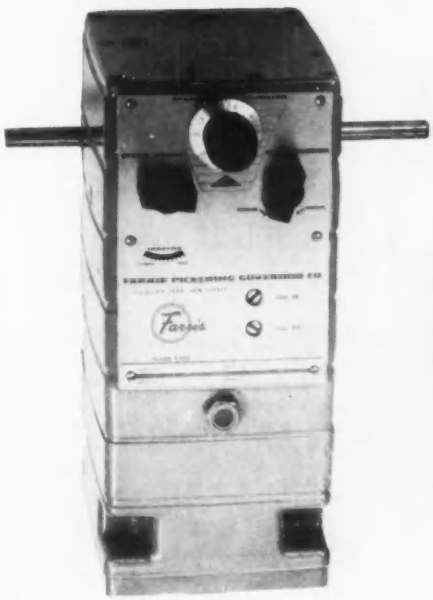


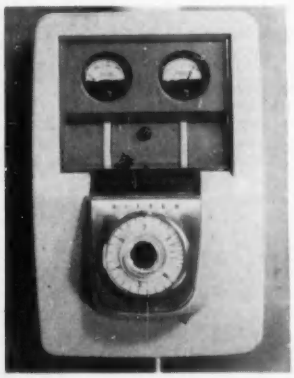
A

B

in appearance design...

Pre-packaging scale for supermarket operators (left) has numerous advantages. Operator efficiency is increased by large, easily read price and weight scale; glare is eliminated by slanting the glass that covers the dials. Removable, stainless-steel weighing pan simplifies cleaning. The engine governors (below) are another example of the advantage of intelligent industrial design. The newest of a complete line of governors (left) has all controls grouped for easier adjustment. Previous models (right) had controls on two sides and the top. Castings for the new governor are simpler, cheaper to produce and easier to chuck for machining. Scale designed for Toledo Scale Co. by J. M. Little & Associates, Maumee, Ohio. Governor designed for Farris Pickering Governor Co. by Peter Schladermundt Associates, New York.





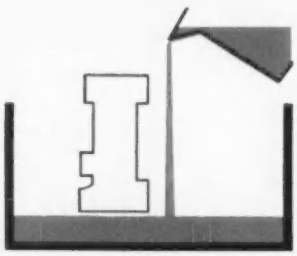
C

New: versatile urethane foams

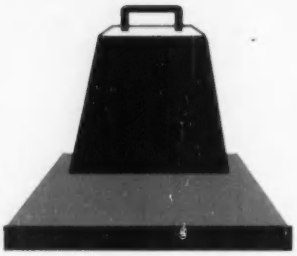
for thermal insulation, structural reinforcement,

Urethane foams offer you an unmatched combination of properties for industrial design. They can be produced in rigid, semi-rigid or flexible forms. They can be foamed-in-place at normal temperature and pressure in densities from 2 lbs./cu. ft. to more than 20 lbs./cu. ft. They "self-adhere"

TYPICAL PROPERTIES OF URETHANE FOAMS



FOAMING IN PLACE from a liquid stage *at normal temperature and pressure* permits new cost savings in design, manufacture, maintenance. Urethane foams expand and solidify rapidly in the confining area of any cavity; form a tight bond to most surfaces while foaming. Complicated forms can be filled completely without expensive fittings or fabrication. Structural reinforcing can be simplified with foam-filled "sandwich" panels using thinner outside surface materials.



PHYSICAL PROPERTIES of urethane foams make them the most versatile of all foam materials. For example: *Compressive Strength* of a 10 lb./cu. ft. rigid foam is in the range of 200 lb./sq. in. at 50% deflection (75°F.). At 20 lb. density it is 600 lb./sq. in. Its *Flexural Strength* is 275 lb./sq. in. at 10 lb. density; 750 lb./sq. in. at 20 lb. density. The *bond strength* between foamed-in-place urethane and its substrates is excellent.

AS INSULATING MATERIALS urethane foams are exceptional. In *thermal* applications they are equal or superior in K value to all leading commercial insulations. At densities below 10 lb./cu. ft. their K factor is under .30. They are considered low temperature insulating materials (up to 250°-350°F.). Low density foams are particularly effective for *acoustical* insulation. Higher density foams, when required for structural strength, also reduce sound transmission. Vibration dampening, too, is excellent.

made with Du Pont HYLENE*

sound absorption, vibration dampening

to most surfaces while foaming. They have K factors as low as .21. Their cell structures are controllable. / *HYLENE is Du Pont's trademark for its organic isocyanates—key ingredients supplied by Du Pont to formulators of foaming compositions. Mail the coupon today for further details.

Write for our new, free booklet describing the properties and uses of urethane foams.

URETHANE FOAMS
made with DU PONT HYLENE

DU PONT
REG. U. S. PAT. OFF.

Better Things for Better Living
. . . through Chemistry

E. I. du Pont de Nemours & Co. (Inc.)
Elastomer Chemicals Dept. PEH-9
Wilmington 98, Delaware

☐ Please send me a copy of your free booklet, "Rigid and Semi-Rigid Urethane Foam."

☐ Please send me a list of foaming composition suppliers.

☐ I'm interested in urethane foams for possible application in

_____

Name _____ *Title* _____

Firm _____

Address _____

City _____ *State* _____

How Product Planners Work in CANADA

A company development program is helpful in the US, but essential farther north. Here are hard-earned pointers from the 27-year-old system at Canadian Industries Limited.

MONTREAL—(McGraw-Hill World News)—A Company Development Department, concerned mainly with planning for a company's ordered growth, is becoming the vogue in a growing number of Canadian companies. The department is entirely divorced from actual product development and technical research; its purpose is to study long-term market changes and new scientific developments for opportunities and threats to company survival.

Why Canada especially?

Markets and population are relatively thin here—roughly a tenth of the opportunity in the US. At the same time, competition is intense. Often, it's initiated by US companies seeking markets for the "top" and usually lower-cost portion of their production.

Too, in contrast with the US, the Canadian economy is an "open" one, highly sensitive to disturbances in the import-export pattern. For instance, a 2% overproduction of textile products in the US can drastically dislocate Canadian textile marketing. Similarly, the present 5%-plus rate of exchange on the Canadian dollar dilutes the effect of low tariffs on many imported products, and seriously affects earnings of Canada's exports. Geographical problems and sharp seasonal patterns also focus attention on the need for development studies.

Independent development departments are fairly common. At Canadian Industries Limited, Canada's largest chemicals producer, this department is a highly organized prototype. Development studies at C-I-L extend back over a period of 27 years. In the past 10 years, the company has laid increasing stress on "investigational" (as opposed to "physical" or "commercial") development: **The study, analysis and evaluation of new ventures or of technical, commercial and economic situations related to the company's operations and expansion.**

True, C-I-L's Development Department is co-ordinated with the Research Department at the vice-presidential level. And it does point out areas where physical research might most profitably be undertaken. But its prime purpose is "to look down the road" and forecast the shape of the company ten years (or more) hence.

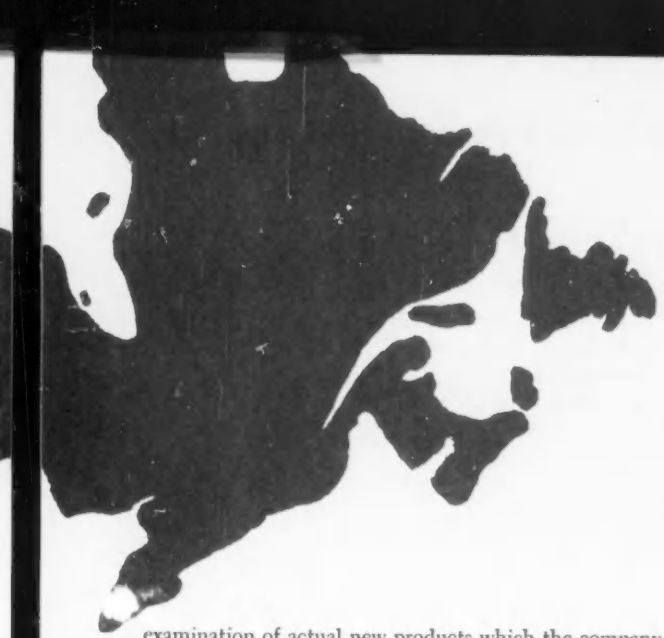
To accomplish this, C-I-L's development manager directs a team of 40, including 28 technical personnel: economists, engineers, chemists, accountants, mathematicians and commerce graduates. Of these, most will have had prior experience in one or more of the company's eight operating divisions: Chemicals, Agricultural Chemicals, Explosives, Ammunition, Plastics, Paints, Textile Fibres and Coated Fabrics. They staff these five main sections in C-I-L's centralized Development Department:

- **General Studies**—Evaluates long-range significance of new technical developments, and explores technical feasibility of new ideas. If, after preliminary examinations here, an idea still looks good, it's referred to other sections for detailed study.
- **Economic Studies**—Operates an economic intelligence service and carries on all work normally expected of economic advisers in a company. In most companies, this operation would fall under Accounting.
- **Commercial Studies**—Handles all market-research work and commercial and financial investigations.
- **Technical Studies**—Tackles all investigations involving engineering, costs, profitability and technical matters.
- **Study Services**—Supervises information, library and clerical services, and handles administrative studies.

"Ideally, it's best not to let the staff get too unwieldy," says Bernard J. Moriarty, development manager. "If an especially large task force is needed—as was the case when we planned our polyethylene and ammonia plants—we call on the general managers of interested operating divisions for the right people." At C-I-L, each operating division also looks after its own development work. In most manufacturing divisions, research and development are complementary efforts, under the direction of a division manager.

In the central Development Department (theoretically a service department, like Accounting, Engineering, Research, Public Relations) two types of advisory functions are undertaken for C-I-L's executive management:

- **Basic long-range planning.** This extends into the



examination of actual new products which the company might produce.

• **Special topics** on which management may wish opinions or information. Usually, they cut across a number of the operating divisions, and run through commercial, economic, technical and administrative matters. Typical of special studies were those concerning the impact on the Canadian economy of the St. Lawrence Seaway and Trans-Canada Pipeline.

Because both functions involve the same basic skills, it's convenient to handle them in a single department. In the strictest sense, C-I-L's development department is not a "service" department. Mainly, it goes its own way, reporting to top management, and complementing the research and development work of the operating divisions rather than servicing them.

"In our program," says Moriarty, "the Development Department tries to maintain a balance between the long-range economic studies and the studies of specific products. This way, we get a continuing flow of ideas as well as a current program of actual investigation into new prospects. Product studies usually proceed step by step. During each succeeding stage, increasing accuracy of estimation is needed and assistance may be secured from the Accounting and Engineering Departments. Quite often, one of the divisions will participate in our investigations."

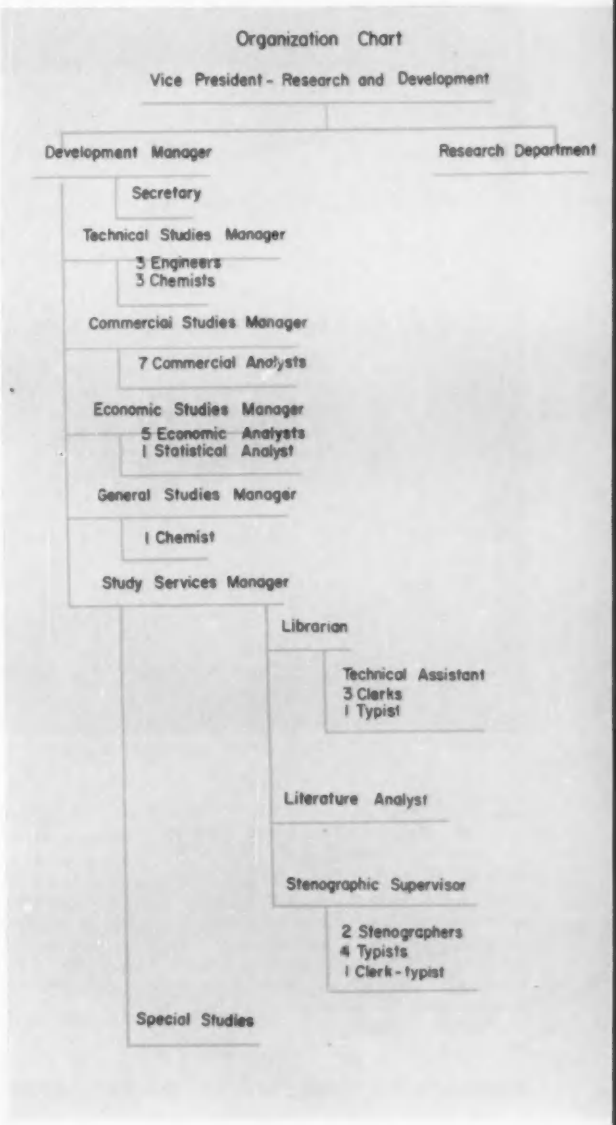
Throughout the study, markets, costs, selling prices, etc, are considered under foreseeable future conditions. The idea is to judge profitability under a range of circumstances. If the return on capital under the most probable conditions looks compatible with the risk, it's recommended to management that an accurate appropriation estimate be made.

Then, if the Development Department's recommendation is picked up, the manufacturing division which would produce and sell the product is asked by management to review the Development Department's work and to extend it sufficiently to make a recommendation. Obviously, this is crucial. The responsible division must be convinced of the worthiness of the venture, and satisfied that the prospects are good, if wholehearted and enthusiastic cooperation are to be expected.

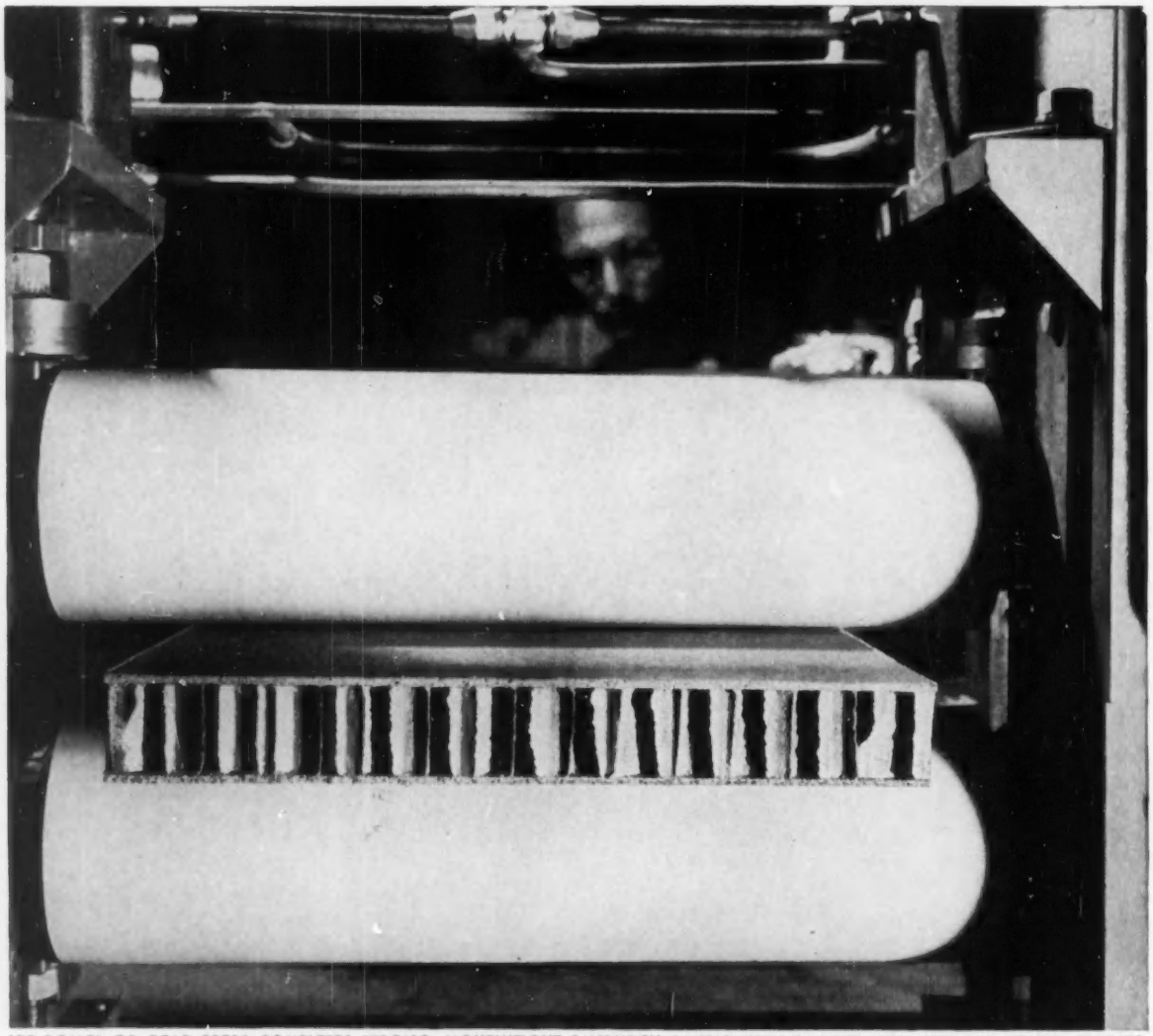
Nearly always, a study involves a high degree of interplay between the five main study sections of the development department. One section may have primary responsibility, but the team is usually built up from more than one.

C-I-L's development department isn't shutting itself off from the rest of the company. A new research and development committee is now being formed to establish policy and provide co-ordination on a company-wide basis. All operating divisions will be represented, along with the Development, Research and Engineering Departments. The vice-president of research and development will be chairman. Through this committee and through the development manager he will be able to coordinate the development work right across the company.

Meanwhile, splitting development off from physical-research efforts—then tying it back in under a common vice-president—looks like one answer for long-range planners.



For fast, cold sandwich bonding ...3M Adhesive EC-1357



NIP ROLLER OR COLD PRESS COMPLETES STRONG, LIGHTWEIGHT SANDWICH PANELS WITH EC-1357. YOU NEED NO HEATED PRESSES.

Gain the speed and economy of cold bonding! Fabricate sandwich panels for non-load bearing uses with 3M Adhesive EC-1357.

This high-strength, flexible adhesive bonds sandwich panels without clamps or heated presses. You force-dry the solvent out of the adhesive before bonding. Cold press or nip roller finishes the job. You get maximum immediate strength. And EC-1357 builds up even more strength with age as it cures at room temperatures.

Because it is dark in color, EC-1357 absorbs drying heat fast. Thus it cuts production time, allows continuous movement from adhesive spraying to finished panel. EC-1357 resists moisture and normal temperatures, too. For load-bearing panels, investigate 3M Adhesive EC-1177.

SEE WHAT 3M ADHESIVES CAN DO FOR YOU!

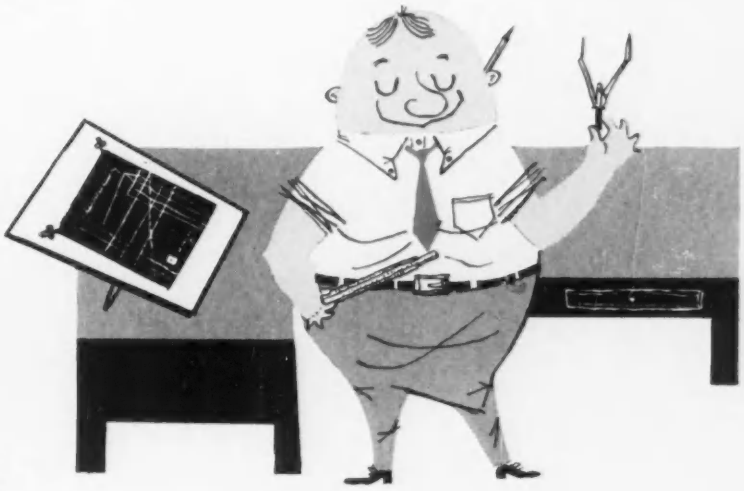
Consult 3M research. Contact your 3M Field Engineer. Or for information and free literature, write on your company letterhead to: 3M, Dept. 79, 417 Piquette Ave., Detroit 2, Mich.

PRODUCT OF 3M COMPANY RESEARCH

MINNESOTA MINING AND MANUFACTURING COMPANY • ADHESIVES AND COATINGS DIVISION

417 PIQUETTE AVE., DETROIT 2, MICH. • GENERAL SALES OFFICES: ST. PAUL 6, MINN. • EXPORT: 99 PARK AVE., N.Y. 16, N.Y. • CANADA: P.O. BOX 757, LONDON, ONT.

A. H. KURILOFF
Sr. Design Group Engineer
Convair
A Division of General Dynamics Corp.
(Astronautics)



KEEPING ENGINEERS HAPPY

. . . is the responsibility of their immediate supervisor.
An engineer is an individual and must have his normal human needs recognized.

The management of any company producing technical goods must acknowledge that its business structure is founded on the quality of its engineering. Clear-cut recognition of the professional character of its engineers is the surest way to promote a professional quality in its engineering. A management unwilling to accept, or deliberately rejecting, this attitude pays a severe penalty in reduced output, slovenly design and indifferent technical achievement.

The engineer must be made an integral part of management with responsibilities, rights and privileges no different than those of at least a junior vice-president. The engineer then attains the dignity and stature of an individual. Engrossed in the creative activity which should be his rightful sphere, he is free from the doubts, fears and pressures surrounding the average white collar worker. If management decries the current movement toward unionization of engineers, the surest way to stop its progress is to recognize engineers as professionals.

Key man in this program is the supervisor. There are three areas in which the supervisor can exert pressure:

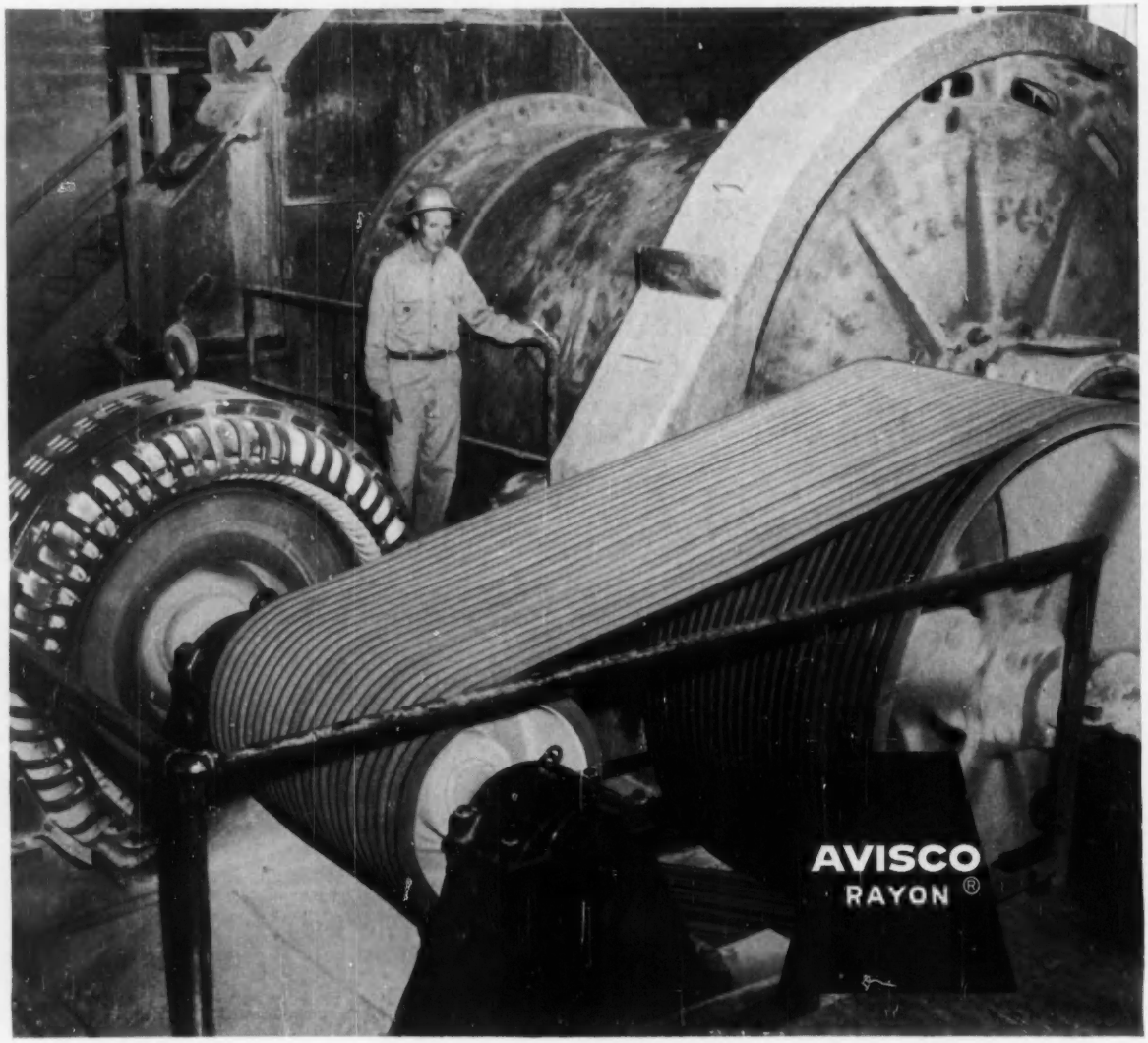
By letting his engineers know what is going on. At regular meetings he can show how the group effort is integrated into the total company effort. He can point out the value of their contribution in the overall pattern. Any man works better when he knows where he is going.

By emphasizing the engineer's place in society. This he can do by pointing out the value of the work of the group. A radar system capable of bringing an airplane safely home through fog and storm is a worthwhile thing. A small improvement in efficiency of a mass-produced electric motor is multiplied over and over to relieve the burden of human effort.

By recognizing the human needs of the engineer for a balanced ration of work. Any man needs a balanced work diet as much as he needs a balanced diet of food. No engineer can remain chained to desk or design board hour after hour. He needs some variety. How much depends on the man.

It is management's responsibility to orient the supervisor in this method. The supervisor can quickly learn the fundamentals of human relationships. By employing skillful teachers to train its engineering supervisors, management can make a vital contribution toward a more successful engineering enterprise.

It is the line supervisor's immediate responsibility to know the fitness of a man for his job. In daily contact the supervisor can sense instantly when some-



Six years of continuous operation, without losing an hour. They're B. F. Goodrich Multi-V belts, with Avisco rayon as tough reinforcing "muscle," and they promise to last many more years. This performance since 1951, under conditions requiring greatest strength, flexibility and freedom from elongation, may suggest an application in your business. And remember, Avisco rayon gives greater strength per dollar than any other reinforcing material.

American Viscose Corporation

350 FIFTH AVENUE, NEW YORK 1, NEW YORK

thing is wrong. A look, a gesture, listless attention to the task—these are immediately apparent. Many an engineer has been saved for the company and made a more productive and happier man by switching him from one kind of work to another.

An engineering supervisor can suggest or modify action. But except in unusual circumstances he should not order action directly. This means that he can give or deny the go-ahead to a design. He can suggest modifications. But if he wishes the best from his engineers, he will be well advised to allow them freedom.

Praise for a good design job results in more and better design jobs. Clear-cut acknowledgement of ingeniousness produces more ingenuity. Encouraging the designer to explore alternate approaches makes it easier to select the most appropriate method—while the design remains the brainchild of the designer.

The engineer is proud of his ideas and resents direct criticism. The wise supervisor encourages this pride, yet steers it by tactful encouragement and suggestion.

The measure of the success of the design group is the technical excellence of its product. The measure of effectiveness of the group is its efficiency. The more technical responsibility given to the group, the more effective it will be.

How does a supervisor increase technical responsibilities within his groups? Two factors are involved: Selecting the man ready for responsibility, then teaching him how to grow into more and larger responsibilities. The supervisor can tactfully guide the newly designated responsible engineer into a successful venture. It is important that a man be successful in his first task.

An effective way to acknowledge accomplishment is the public display of a finished product at a company "Open House", trade fair or technical society exhibit. The designer then identifies himself with the product and the company. In no other way can a man so forcefully see the worth of his work, its end use and public acceptance.

Visits to companies in the same business, to vendor's plants, to professional conferences, to military installations, serve to freshen an engineer's outlook and sharpen his perspective. By seeing how others do things he often is able to improve his own way of doing things.

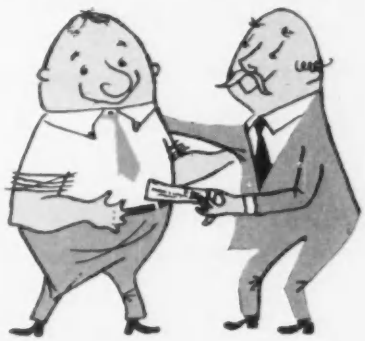
Such trips should not be in the nature of rewards. They must be a normal part of professional engineering work. The significance of this approach lies in the tacit acceptance that part of the professional engineering job is in keeping up with the state of the art by meeting and consulting others.

WAGES

Most companies require formal periodic review of the engineer's performance. At this time the supervisor speaks of strengths and weaknesses—and of raise in pay. The approach should be objective and as honest as possible. But praise for accomplishment should not be limited to this occasion. It should occur from time to time as warranted on the job.

In a large company, it is customary to rate the men in order of estimated worth to the group. Salaries are increased for three reasons: marked improvement in quality and quantity of work, marked increase in job responsibility, or adjustment of inequities, as when a man's salary lags significantly behind his position on the rating chart.

Any favoritism in adjusting salaries will flare into a fire. The supervisor should be as generous as he can in recommending raises. When a man takes his raise home to his wife, it should be something significant,



large enough to merit praise. It is better to give raises less often, in more generous quantity. This is substantial recognition of professional merit.

The same approach applies to bonuses. For outstanding and meritorious contribution, a generous bonus is a most acceptable form of recognition. Given with praise, a bonus is the high point in a professional engineering year.

PROFESSIONAL ACTIVITIES

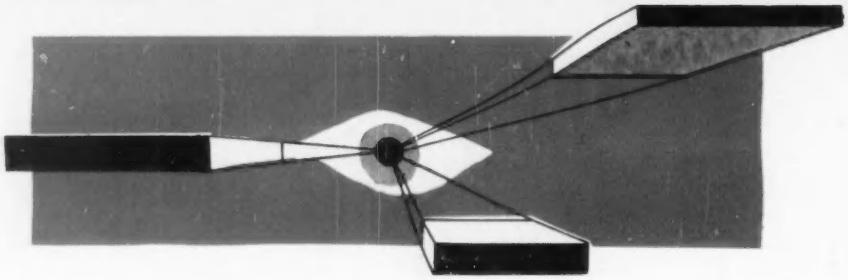
Many companies encourage their engineers to further their professional training, education and participation in professional activities by financing such participation in whole or part. This form of financial help underlines the company's recognition of professional stature among its engineers and makes its engineers more professional.

Management should not be content merely to finance advanced education, which would be a waste if the new skills were not put to work on the job.

The engineer should be encouraged to become a Registered Professional Engineer. This requires passing a State Board Examination. The company can help by financing special review courses aimed at these examinations. Achievement of registration is a public mark of professional recognition.

Some companies make special awards to their engineers for publishing technical papers. The name of the company is publicized in precisely the field of its endeavor and the recognition attached to authorship of technical articles is most satisfactory to engineers.

A public acknowledgment of a job well done, a pat on the back, a clear-cut statement of appreciation for an excellent piece of work—these are things that lend satisfaction to doing a job. Without such acknowledgment occasionally, we all lose our eagerness for the work—the work suffers and so do we.



POINTS

THE QUESTION: What Factors Enter Into Your Decision to Re-Design An Existing Product Rather than Design Anew?

"Developments in related fields . . .

often influence our decision. Like many other companies that produce a highly engineered product or component, our product lines are governed primarily by the performance requirements of airframe and engine manufacturers. We are supplying both flexible metal hose and wire-braid-covered plastic hose for hydraulic and fuel systems. In the next few years, it is extremely probable that temperature requirements will be so high that our present plastic hose will not be applicable. If this happens, we will have several alternatives: (1) redesign our plastic hose; (2) redesign our present metal hose; or (3) develop a completely new flexible hose.

"One factor that will determine which one we choose will be new materials and processes then available. On the other hand, a new process may be developed which would make our present type of construction obsolete. This would involve a new product development program."

E. M. RAMBERG
Vice-President, Engineering Titeflex, Inc.

T. M. BUTLER
Director of Engineering, Burroughs Corp.

"A new machine . . .

or the redesign of an existing one is a decision which is left to product planning and engineering. Mainly, ideas come from three sources: market requirements as reported by sales personnel, suggestions originating with Product Planning, and proposals submitted by Engineering. Of these, ideas obtained through sales are likely to cover improvements in existing equipment, while those originating in Product Planning and in Engineering are more often wider in scope.

"In any case, Product Planning requests Engineering to investigate a specific project, and to give the specifications of the proposed equipment. As a result of this investigation, Engineering recommends the redesign of existing equipment or development of a new product concept."

OF VIEW

"The advancement of a given art . . .

and our ability to do a given job better is the primary decision between redesign and a new product. With the preponderance of our work under Government contract, it is necessary for us constantly to maintain our position in the competition for these contracts. We have found both our management and the government to be receptive to the consideration of new designs.

"Reliability, in itself, is now a potent stimulant for redesign; for example, the use of transistors in place of vacuum tubes. The decision is based upon the best information available as to the wants of a customer. In this regard, market research is used to determine customer desire and our ability to satisfy those wants."

ROBERT J. SEYMOUR
Manager of Product Planning
Ford Instrument Co.

BENTON BEJACH
Manager, Product Planning
Small-A/C Motor and Generator Dept.
General Electric Co.

"Requirements of our customers . . .

for improvement in electric motors is the most important factor in developing new products. Changing technology in the new industries we serve creates new applications which can best be satisfied by starting from the ground up. Naturally, market research, predicting a steadily increasing market, has been a vital factor in creating our recent new line of Tri-Clad '55' motors. Automated production facilities were needed to keep up with America's increased need for more horsepower per worker. On the other hand, the nature of the motor business is such that redesigning existing products is frequently done for special applications."

"Consumer's acceptance . . .

of the product in quality, styling, features, performance and price is a prime factor in such a decision. Our Product Development Committee generally bases its decisions on the redesign of an existing product, or the development and tooling of a complete new product on the marketing, sales and service experience obtained by our national and international distribution.

"The influence of continuing research in product development and manufacturing processes can reveal the potential economies that can be made in the proper application of improved or new mechanisms, new materials and improved production methods that would make the product more attractive to the consumer in appearance, performance and price."

W. J. RUSSELL
Vice-President, Engineering,
Landers, Frary & Clark

9 Guideposts to Successful Product Planning

IRWIN P. SHARPE, *Irwin P. Sharpe & Associates*

If you are a gambler and like to play hunches, play the horses—but stay away from new products. According to studies made by the National Industrial Conference Board[1] and others, the odds are heavily stacked against the success of a new product. Whether your company is large or small; whether it manufactures consumer goods or industrial products; the grim fact is that for every five consumer products placed on the market, only one is successful.[2] This pitifully poor batting average is based only on products actually placed on the market. No one has ever counted those discarded after various stages of design and development.

This is the experience of large manufacturers—those with know-how and resources. In small businesses, success is even rarer. The appalling fact is that 49 out of 50 products are withdrawn from the market during their first two years of sale.[3]

Today, the engineer can design almost any desired product. He can make your products more efficient, less costly, or with longer working lives. But the best engineering brains in the world may not be able to design products a customer will buy.

New ideas and technologies are born in the laboratory, but the design of a successful product starts with the customer. To be accepted, a product must have the features a customer wants. It must be priced at the level he is willing to pay. It must be available where and when he wants it.

Many forward-looking corporations have been developing a scientific approach to marketing. Known as product planning, the method was pioneered by General Electric. Burroughs Machine Company now calls product planning the "key to survival." It has been the catalyst for the spectacular growth of Minnesota Mining & Manufacturing Co.

WHAT IS PRODUCT PLANNING?

A new product idea may come from anywhere: from the research laboratory, from the engineer, from the salesman, from the customer, or even from the boss. But success or failure depends on what is done with that idea. Product planning will appraise the idea from standpoints of customer, market and the over-all business. The appraisal is then converted into product specifications having meaning to an engineering group. Finally, product planning integrates the thinking and the efforts of marketing, engineering and manufacturing so that the right product, together with its marketing program, is ready on time.

The product plan must be fitted to the needs of the company and to the nature of its business. It must integrate many diverse and conflicting elements. If there is to be any reasonable chance for success, nine major areas should be examined.

1. ***Analyze the market.*** **How big is it? What is the trend? What is the potential? Who are the customers?**
2. ***Analyze the product.*** **What features must it have to satisfy customers' needs, habits and desires? Which features will they value and pay for? Which are not important to them? What should the pricing strategy be? What is the minimum product line that will balance market coverage with factory standardization?**
3. ***Evaluate competition.*** **What is its extent, its strength? What are its weaknesses? Which features of competitive products are important to the customer? What is the pricing situation?**
4. ***Evaluate the need for technological development.*** **To what extent do present products satisfy specific customer needs? Where is there opportunity for imaginative design to meet market needs?**
5. ***Appraise distribution.*** **Can the product be sold through the company's regular channels of distribution and with its existing sales organization? How much advertising and promotion will be needed to introduce the product?**
6. ***Appraise the effect of the product on the existing business.*** **Can it be made with existing manufacturing facilities? Does it require special talents? Does it have seasonal characteristics that will help or hinder the existing business? Will it increase or decrease the sale of existing products?**
7. ***Determine financial requirements.*** **How much investment will be required to handle development, manufacture and marketing of the product? What are the probable short- and long-term returns?**
8. ***Prepare product specifications.*** **Convert the market and business information into specifications that will guide the design so that it results in a commercially acceptable and economically producible product.**
9. ***Integrate the product program.*** **Are objectives set up and responsibilities assigned? Does the time schedule cover all important elements of the program? Is it organized to be followed through? Is the program on the right track—on the track of commercial success?**

These are just guideposts. To be useful, to give them direction and meaning, they must have the right climate. A company must really want a successful product program, it must be organized for it, and the program must have the backing of the chief executive.

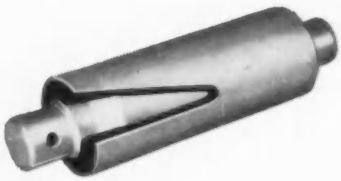
1. National Industrial Conference Board, *Studies in Business Policy*, No. 69, 1954, p. 5.
2. Small Business Administration, *Small Business Management Series*, No. 17, 1955, p. 63.
3. *Ibid.* p. 3.

Engineered Rubber Products

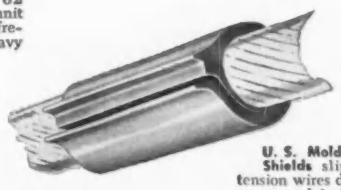
Mass-produced to exacting specifications

U.S. Molded Train Diaphragm (left) for new "Talgo" and other lightweight trains provides neater, stronger, more flexible covering for joints and couplings. That's why it was selected for these revolutionary trains. To keep up with the modern "look" and performance of this new railroading design, this "U.S." bellows-type diaphragm flattens out or compresses as the train takes curves at speeds never before attained. To do this and still retain its shape and strength, the diaphragm was carefully engineered of cloth-inserted, fire-resistant neoprene rubber, produced to the exact specifications of the customer.

This is only one of hundreds of applications where U.S. Engineered Rubber Products do jobs no other material can do, *especially in mass production*. There are factory trained engineers ready to help you solve any molded rubber problem. Contact us at Rockefeller Center, New York 20, N. Y. In Canada, Dominion Rubber Co., Ltd.



U. S. Molded Oil Pump Bearings eliminate 62 conventional pumping unit parts, and absorb high-frequency vibrations and heavy well shocks.



U. S. Molded Line Hose Shields slip over high-tension wires during maintenance and installation. Very flexible, sturdy, resists up to 30,000 volts.

U. S. Molded Diaphragms for motor valves regulating the flow of liquid through piping systems. Precise, uniform molding makes them standard equipment of leading motor valve manufacturers.

Mechanical Goods Division

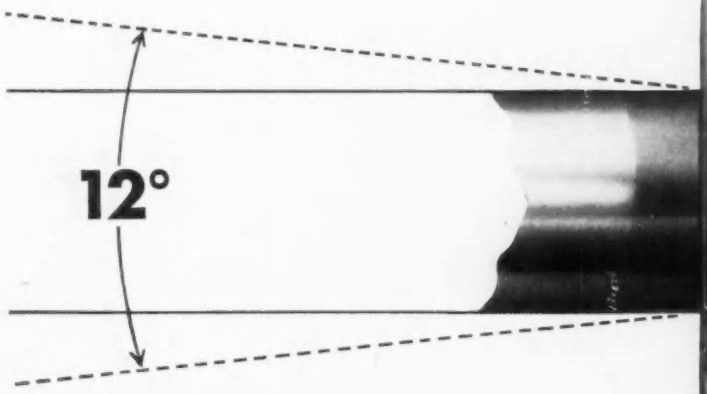
United States Rubber

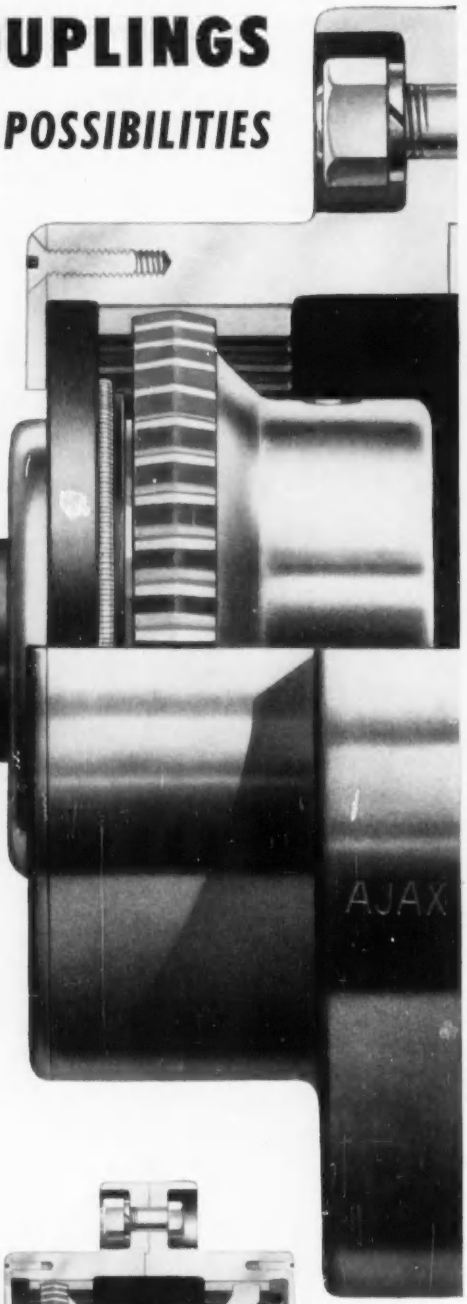
AJAX DIHEDRAL COUPLINGS

OFFER NEW DESIGN POSSIBILITIES

Now you can purposely design angular and offset misalignment into new machines as well as cure the same problems on existing equipment.

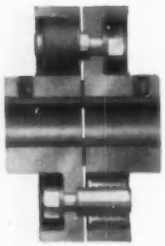
Ability to handle up to 12 degrees misalignment with constant peripheral speed is improving layout of driving and driven components, simplifying manufacture and reducing shut downs and maintenance of a wide variety of equipment.



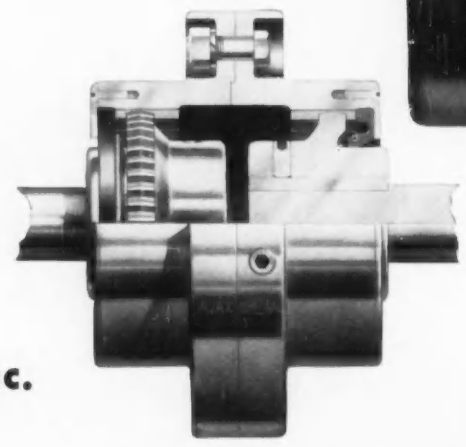


Responsible For Radical Improvements

Radically improved performance is made possible by Ajax Patented Dihedral Tooth Shape. It has been proven by hundreds of installations involving angular drives operating at high speeds and horsepower. A discussion of their advantages may reveal important improvements resulting from their application to your conditions. Ajax representatives are fully qualified to give you the latest thinking on this advanced type of coupling.



Ajax Rubber-Bronze Cushioned Couplings have been the standard of industry for 37 years. Made in a complete range of sizes. Write for catalog.



AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, N. Y.

factory fire fighter

The John Bean aisle-sized fire engine fogs out industrial blazes instantly! *Highly maneuverable*, it can speed directly to inplant fires taking 90° turns from one 8-foot aisle into another, climbing 16% grades fully loaded. *Highly efficient*, its high pressure fog equipment smothers flames with only 10% of the water required by ordinary systems, and with comparably less water damage. *Completely dependable*, it is powered—both the truck (built by HH Manufacturers) and the pump—by a big-output, low-cost Chrysler Industrial Engine.

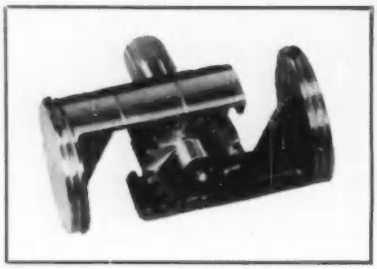
CHRYSLER INDUSTRIAL 30 in-line 6 Engine (230 cu. in. displacement) powers John Bean Industrial Fire Fighter—and many other makes of equipment in the industrial, construction and materials handling fields. There are four Chrysler in-line 6s, two V-8s—ranging from 230 to 354 cu. inch displacement.

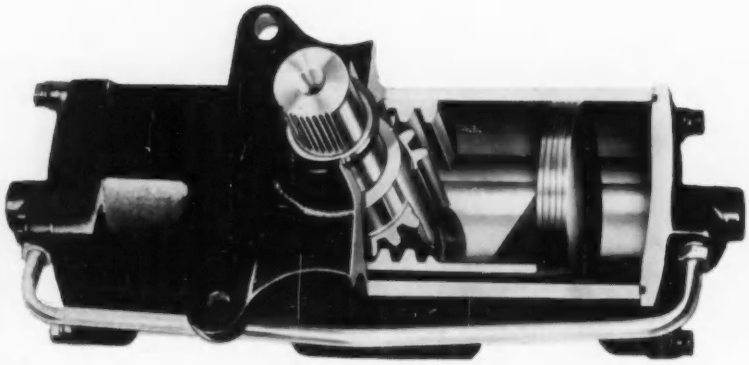
Chrysler
INDUSTRIAL ENGINES
INDUSTRIAL ENGINE DIVISION • CHRYSLER CORPORATION

Write Dept. B-9, Industrial Engine Division, Chrysler Corporation, Detroit 31, Michigan, or see your nearest Chrysler Industrial Engine Dealer.
☐ For specific detailed information ☐ For descriptive literature

NAME
ADDRESS
CITY ZONE STATE

SIGNIFICANT PARTS



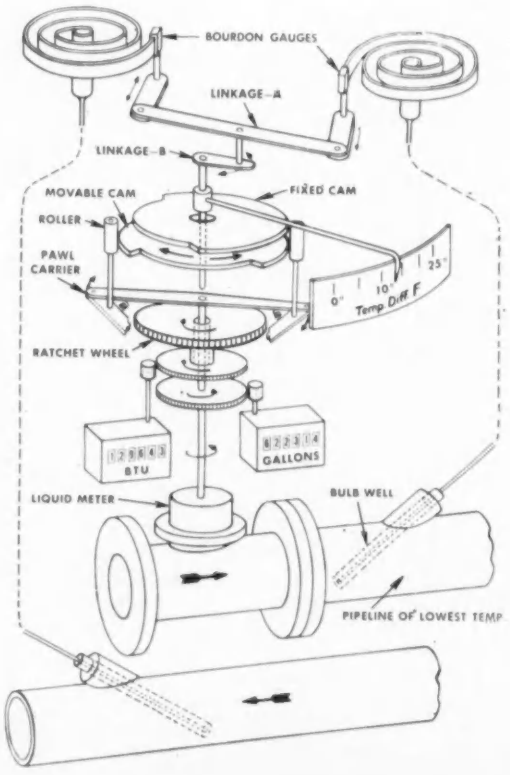


Rotary Motion from Any Hydraulic System . . .

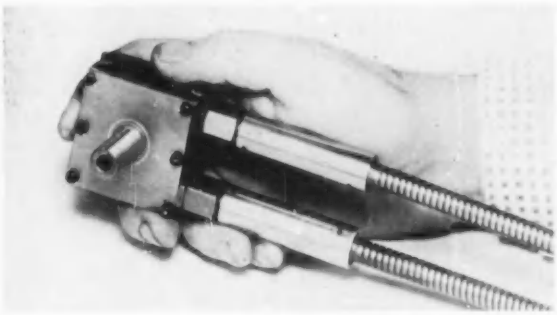
is possible with this double-acting, twin-piston cylinder—presently used in power steering system of a heavy-duty truck. Pressure applied to the outer-piston chambers produces counter-clockwise shaft rotation up to 96°; applied to inner chambers, it gives comparable clockwise motion. Shaft locks wherever positioned by pistons. At 700 psi cylinder delivers approximately 26,000 in.-lb torque. Custom-built, with delivery in approximately two months. **Michigan Div., Thompson Products, Inc., 34201 Van Dyke Ave., Warren, Mich.**

Mechanical BTU Meter . . .

measures heat in thermal units and liquid flow in gallons. It can indicate heat absorbed and heat removed from a liquid in individual areas or containers; is adaptable for fluids encountered in industrial and chemical processes. A meter measures liquid flow, while an integrator combines the difference between supply and return temperatures, and flow through the liquid meter, giving an automatic total in Btu's. Total gallonage is recorded on a second counter. Rates of flow range from 2.6 to 8800 gpm. Directly above these two counters is a pointer indicating temperature differentials. Prices are from $550 to $3400, through ½ to 20-in. size range. Delivery is four weeks after receipt of complete customer specifications. **Air Conditioning Equipment Corp., 219 E. 44 St., New York City.**



MATERIALS · EQUIPMENT



Remote Controller of Position and Angle . . .

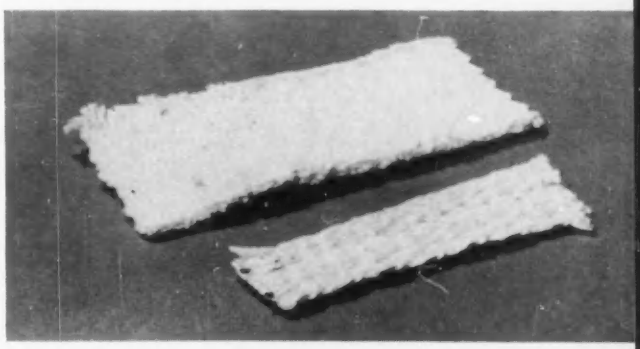
combines rotary and linear motion, so is suitable for positioning direction-sensing probes in a fluid stream, but it can also provide up to 100 lb thrust for control-system applications. Linear position is adjustable and can be measured to 0.001 in. accuracy; maximum linear traverse speed is 6 in. per minute. Rotation is measurable to 0.1° and unlimited in either direction, with a maximum speed of 1.5 rpm. Drive is through flexible cables from a motor box approximately 10 ft away, which contains motors and selsyns, electric clutches and limit switches. Motor box is connected to control transmitter by an electric cable that can be over 100 ft long. Units are adapted to specific applications. Complete system, as described, about $1200; 4 to 6 wk delivery on custom-built units. **Aerotech Specialties, Inc., Glastonbury, Conn.**

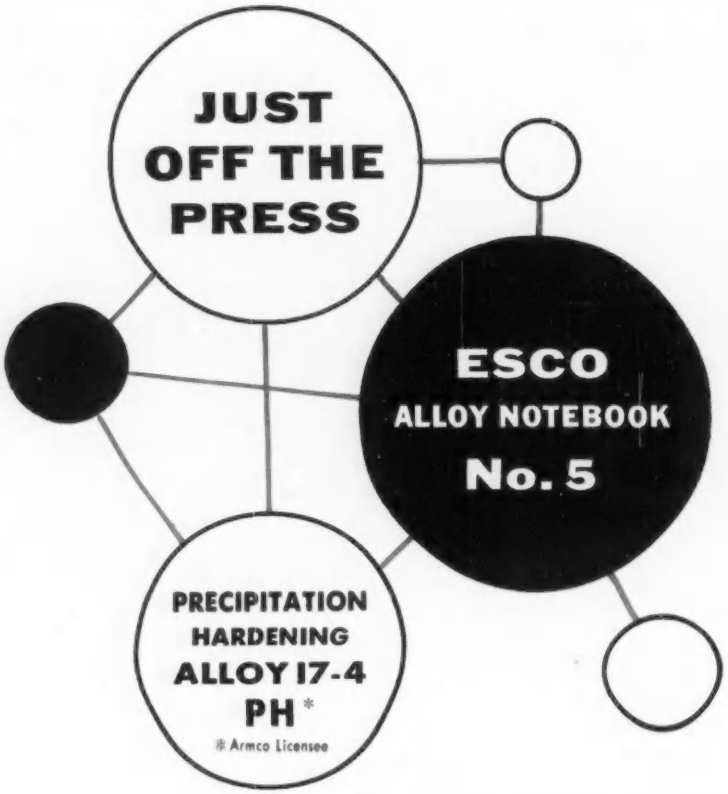
Flexible Shaft . . .

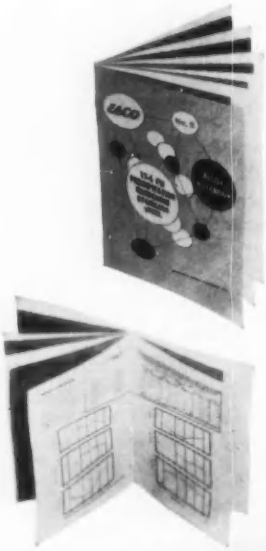
based on universal joints has equal torque in both directions and can be used for remote controls and power drives. Links consist of trunnion blocks and two half links, fastened with screws or rivets. Cover materials available include armored neoprene hose, nonmetallic hose or semi-rigid tube. Torque ratings for manual torsional movement are 50 in.-lb for ⅜ in. shaft, 200 in.-lb for ½ in. shaft and 2500 in.-lb for 1¼ in. shaft. Maximum available shaft diameter is 3 in. Delivery is scheduled at from 2 to 4 wk, depending on specifications. **Clark Flexible Link Shaft Co., Box 73, Newton Highlands 61, Mass.**

Twin-purpose Ceramic Fabric . . .

insulates or detects at temperatures up to 1500 F for 1500 hr. Available in sheet widths of 1½ to 4 in. and thicknesses of ⅛ to ⅛‡ in. for insulation, and as tape or tubing for insulation and/or leak detection. Tape consists of two stranded Chromel wires covered with reinforced ceramic fiber. When wrapped around pipes, it insulates and also will cause an alarm-sounding short circuit if a leak occurs. These fabrics can be spirally wrapped around pipe as small as ½ in. dia; can be treated with silicone rubbers, epoxy resins, or impregnated with phenolic resin and molded into various shapes. Available on order only at $18 per lb, regardless of width or thickness.
Russell Mfg. Co., 341 E. Main St., Middletown, Conn.







Here is the first information published on the mechanical properties after various heat treatments, of cast alloy 17-4 PH. This true heat and corrosion resistant stainless steel can be machined, in its relatively soft as-cast condition, and hardened to 400 BHN at low temperatures. 17-4 PH also has the ability, through heat treating, of being adaptable to a wide range of applications requiring high strength, ductility and impact resistance.

This report of a continuing study contains pictures, tables and graphs, showing such things as the microstructure before and after annealing and the comparative mechanical properties of 17-4 PH.

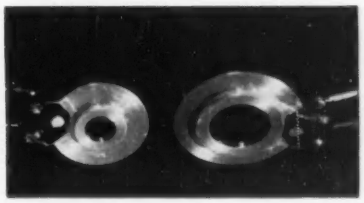
Industry as diversified as aircraft parts, food processing equipment and chemical pump manufacturers are among the enthusiastic users of Alloy 17-4 PH.

Write for your free copy today.

ESCO®

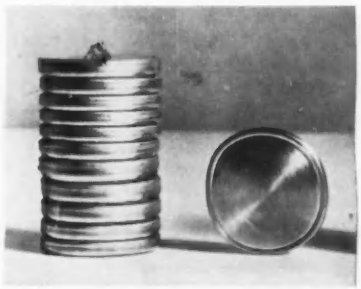
ELECTRIC STEEL FOUNDRY COMPANY

2177 N. W. 25TH AVE. • PORTLAND 10, OREGON
MFG. PLANTS AT PORTLAND, ORE. AND DANVILLE, ILL.
Offices in Most Principal Cities
ESCO INTERNATIONAL, NEW YORK, N. Y.
IN CANADA ESCO LIMITED



Transducer Measures Force . . .

exerted on a bolt and can be used to measure tie-down pressure when installing, stress in service, or possibly contents or pressure in a tank or boiler. Essentially, the device is a washer wound with three or four turns of insulated copper-nickel wire connected to two output terminals on its shoulder. Compressive force causes the washer diameter to increase proportionately, stretching the wire and increasing its electrical resistance. Accuracy of the resistance-force relationship is said to be better than 2%; repeatability better than ¼% of measured value. Standard washer sizes fit $\frac{7}{16}$ to $\frac{3}{8}$ in. bolts; steel washers withstand up to 640,000 psi, aluminum up to 320,000 psi. Price will be $15-$50, depending on specifications. **Waldale Research Co., Inc., 11626 McBean Drive, El Monte, Calif.**



Button-Sized Battery . . .

is rechargeable and can be stacked to provide unit of any desired voltage (each cell has nominal 1.2 v rating). Operates within nominal temperature ranges. Each cell provides 250 or 500 milliamp-hr of energy, depending on model chosen. Dia is $1\frac{3}{8}$ in. and weight less than 1 oz. Either size is priced under $1.00. Delivery from stock or in less than 30 days. **Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.**

Polyurethane Foam . . .

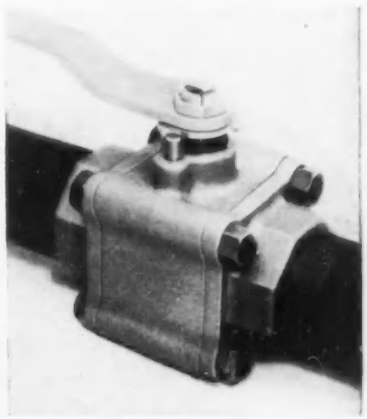
is sprayed onto flat or contoured surfaces and fabricated objects, or into assemblies. Standard paint spraying equipment does the job. Any desired thickness, from $\frac{1}{8}$ to 2 in. is possible, and is claimed to form a surface bond stronger than the material itself. Formulations are available to give densities from 2 to 20 lb/ft, either in rigid or semi-rigid forms, also in nonspray preparations suitable for structural applications; for sound, electrical or vibration insulation; or for experimental contouring. A wide range of formulations is available from stock. Special orders will be filled within a week. **American Latex Products Corp., 3341 W. El Segundo Blvd., Hawthorne, Calif.**

Position Indicator . . .

indicates how much valve or other control system component has closed, opened, traveled or otherwise moved. Operating over leased lines, or standard two-wire hookups, control can be located at any distance, from a few feet to miles. When serving as valve indicator, degree of openness is shown in percentage, with needle moving into color-coded segments at extreme ends of scale. Independent visual (and audible, too) alarms are included to warn of power failure, pressure loss, temperature limitations or overload. Accuracy is said to be within 2%. Available off the shelf. Prices range from $500 to $600. **Sparton Corp., Jackson, Mich.**

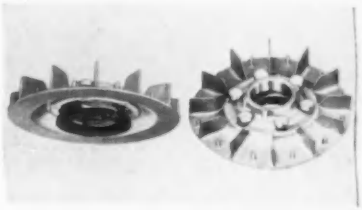
Flow-actuated Control . . .

governs one, two, three or more pumps supplying or pressurizing a fluid. As demand increases or decreases, pumping units are mechanically cut in or shut off. While present installations are rated at 125-150 psi, pressure capacity is primarily limited by pumps and the system to which the control is applied. Available in 4 wk with stock valves or 16 wk with custom-ordered valves. In 4 in. to 12 in. sizes, priced from approximately $500 to $1,000, depending on size and number of motors to be controlled. **Flow-Actuated Control Co., Inc., 101 W. Palisade Ave., Englewood, N. J.**



Bolt-in Ball Valve . . .

contains all renewable parts in its center section, which can be lifted from a line for cleaning or necessary replacements. With the opening in the ball and seat rings same size and shape as inside of the pipe, resistance to flow is minimal. Valve operation is unaffected by reversal of flow. Metal components may be bronze, aluminum bronze or aluminum with carbon steel. Stainless steels will be available soon. Seat and seal materials may be Buna-N, Hypalon, neoprene, natural rubber or Teflon. Available from stock, with 2 to 3 wk delivery at present. Priced $7-$92.50, depending on size and material. **Worcester Valve Co., Inc., 20 Parker St., Worcester, Mass.**



Starting Winding Switch . . .

built into fan for single-phase motors is also useful where cooling is required in conjunction with speed detection. Switch action is determined by speed alone, regardless of voltage or load. Heart of the switch itself is a conically-shaped disk fabricated in one piece from heat-treated spring steel, to which centrifugal weights are fastened. A plastic insulating spool is an integral part of the disk and makes contact with the stationary section of the switch. The fan casting holds the switch mechanism in correct position and is mounted on the motor shaft. Built to order in 4 to 6 wk. **Torq Engineered Products, W. Monroe St., Bedford, Ohio.**

TRUCK BODY–TRAILER MANUFACTURERS CHOOSE ROYALITE... for damage-free paneling of refrigerated units

After thorough testing, several of the largest truck body and trailer manufacturers found that nothing measures up to U. S. Royalite paneling for refrigerated units. Royalite (the industry's standard for A.B.S.* plastics) is extremely light, yet so durable it withstands everyday abuse. Keeps its toughness even at very low temperatures. Is acid-resistant... completely sanitary... easy to clean. Production men have found great economies in assembly costs by using Royalite panels.
Find out how U. S. Royalite can benefit *your* product. Write for information.

*acrylonitrile, butadiene and styrene

US Royalite® NITRILE THERMOPLASTIC SHEET

US RUBBER **United States Rubber**
2638 NORTH PULASKI ROAD, CHICAGO, 39, ILL.

SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .

Delay Relay with Two Timers . . .

is for laboratory or production equipment where recycling is necessary, and for controlling standby electrical equipment. A separate time can be set on each of the timing heads to allow an adjustable 'on' and 'off' from 0.1 sec to 15 min. A time delay occurs immediately upon energization. Delay interval is followed by breaking of one set of contacts and making of another. Timing ranges are marked on dial head in distinguishing colors: 0.1 sec to 10 sec in white; from 0.1 sec to 30 sec, yellow; from 10 sec to 3½ min, red, and from 30 sec to 15 min, blue. Available in either a single-pole, double-throw, double-break type with contact rating of 15 amp at 115 v, 60 cps; or double-pole, double-throw, single-break, rated at 8 amp per contact at 115 v, 60 cps. For a-c or d-c operation. List prices range from $63 to $68. Delivery is approximately 3 or 4 Wk. **AGA Div., Elastic Stop Nut Corp. of America, Elizabeth, N. J.**

Miniature Elapsed-time Indicator . . .

designed for recording of 'on' time. Driven by a 400-cps synchronous motor and a gear train arrangement providing a 14,400:1 ratio. Indicator measures 1¼x1¼x 2¼ in. and weighs 4 oz. Time range is 9999.9 hr indicated on five counter wheels. Unit is hermetically sealed and has two tapped holes on the face for front mounting in a single rectangular panel cutout. Power consumption is 3.5 w at 26 v or 115 v a-c. Samples are available in about 2 wk. In production quantities, the unit, priced at about $50, can be delivered in about 90 days. **Magnetic Instrument Mfg. Corp., 546 Commerce St., Thornwood, N. Y.**

FREE *new* BOOKLET *tells how to get* BETTER PAINT ADHESION

MAIL COUPON TODAY

TURCO PRODUCTS, INC.
6135 SOUTH CENTRAL AVE., LOS ANGELES 1, CALIF.

Please send me your free phosphating booklet and ready reference chart.

NAME_____

TITLE_____

FIRM_____

ADDRESS_____

*If other booklets described below are also desired, please enter numbers corresponding to booklets wanted*_____

PE

Complete PHOSPHATING Reference Chart includes:

- Description of phosphating
- Diagram of how phosphating holds paint to metal
- Illustrations of what phosphating can do
- Types of coatings available
- Recommended uses
- Applicable Government Specifications
- Methods of application and equipment requirements
- Metals to be used on
- Coating weights
- Detailed operation cycles

Here...in the free Turcoat phosphating booklet... is the best solution to any paint adhesion problem. This new booklet describes the *complete* line of Turcoat materials—the coating compounds that assure *permanent* paint adhesion, slash rejects, require less complicated controls and are more economical to buy and use.

Only Turco offers a truly full line of government approved coating materials for use in *any* conceivable processing set-up prior to the use of organic finishes. Only Turco offers a staff of 160 technically trained representatives located in all parts of the country to give immediate 'round-the-clock service. No wonder Turco is adding new phosphating accounts at a phenomenal rate. There are many reasons why, when it comes to *paint adhesion,* more and more industrial concerns are turning to the Turcoat line. The Turcoat booklet lists them all.

BOOKLETS ALSO AVAILABLE ON:

1. Titanium Descaling
2. Stainless Steel Descaling
3. Magnesium Finishing
4. Hot Tank Cleaning
5. Dye Penetrant Inspections
6. Alkaline Rust Removing
7. Spray Washing
8. General Metal Working Compounds

TURCO PRODUCTS, INC.
Chemical Processing Compounds
6135 SOUTH CENTRAL AVE., LOS ANGELES 1, CALIF.

Factories: Newark, Chicago, Houston, Los Angeles, London, Rotterdam, Sydney, Mexico City, Naha (Okinawa)
Manufactured in Canada by B. W. Deane & Co., Montreal
Offices in all Principal Cities

P&B PROGRESS/

UNIQUE DESIGN IMPROVES WEIGHT, SIZE, PERFORMANCE FACTORS

NEW!

Miniature telephone type relay has superior shock/vibration resistance

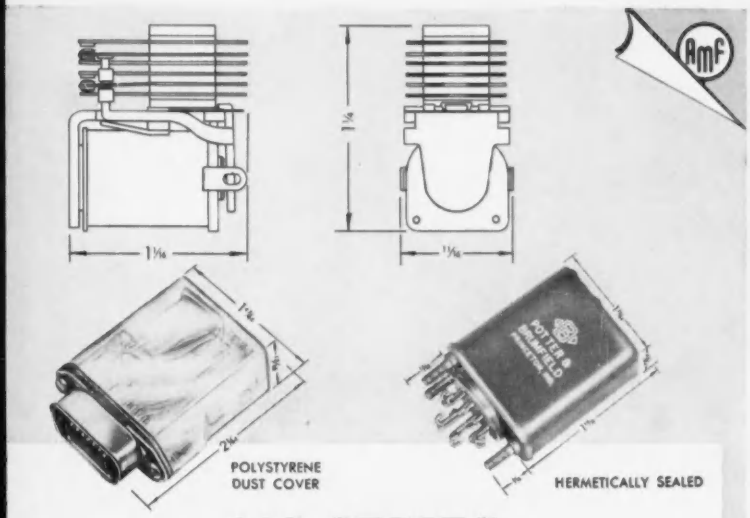
NEW
POTTER & BRUMFIELD
MG SERIES RELAY

Unusual for a telephone type relay, the MG Series has excellent stability under high shock and vibration conditions. Tests show this miniature, light weight (only 1.2 oz., open) relay withstands vibration of 10g 55 to 500 cycles per second and will operate under shock to 30g according to Mil-R-5757C.

The superior performance of the MG is due in part to its unique single stack construction and to an exclusive hinge design which provides zero heel gap.

Open, dust covered or hermetically sealed, the MG is available with contact arrangements up to 4 Form C (4PDT). It is rated for ambient temperatures of −55°C to +85°C. A high-temperature version with a range of −65°C to +125°C will soon be available. Write or wire today for complete specifications and delivery.

POTTER & BRUMFIELD, INC., PRINCETON, INDIANA—SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY



MG SERIES

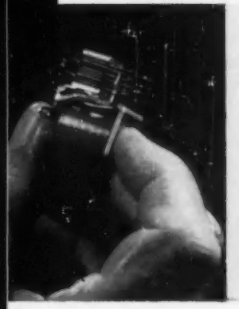
TERMINALS:
Open Relay: Pierced Solder Lugs.
Contacts: Two #18 AWG wires. Coil: Two #20 AWG wires.
Hermetically Sealed:
Miniature plug-in header with 7, 9 or 14 pins. Multiple Solder header with hook and terminals for three #20 AWG wires.
Polystyrene Dust Cover: Micro Ribbon plug-in type.
Mating receptacle: Amphenol #57-20140 or similar.
INSULATION RESISTANCE: 100 megohms min.
VIBRATION: .065" excursion 10-55 cps.
10g 55-500 cps. upon request.
SHOCK: 30g according to Mil-R-5757C upon request.
TEMPERATURE RANGE: −55°C to +85°C.
WEIGHT: 1.2 ozs. (open) 2.0 ozs. (sealed).
PULL-IN SPEED: Approximately 15 ms at nominal voltage.
DROP-OUT SPEED: Approximately 10 ms at nominal voltage.
CONTACTS: 3/32 silver.
CONTACT ARRANGEMENT: 4 pole, double throw (4 Form C).
COIL POWER: 3 watts max. DC @ 25°C. Continuous duty.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC, ELECTRICAL AND REFRIGERATION DISTRIBUTORS
See our catalog in Sweet's Product Design File.

Potter & Brumfield, inc.
PRINCETON, INDIANA

SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY
Manufacturing Divisions also in Franklin, Ky. and Laconia, N. H.

Mail the coupon below for further engineering data on P&B's MG Relay *plus* new compact catalog of standard type relays. If you need answers to a specific application problem, write in detail.

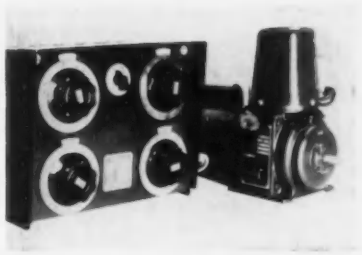


Potter & Brumfield, Inc., Princeton, Indiana
Attn: T. B. White, Brig. Gen. USMC (Ret.)
Special Projects Engineer

Please send me complete engineering data on the MG Relay plus the new compact catalog of P&B standard relays.

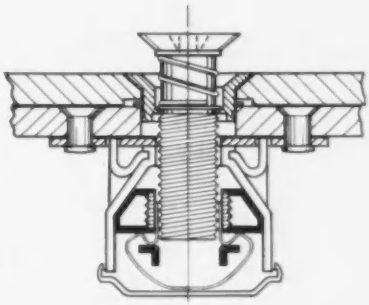
Name_____
Company_____
Address_____
City_____ Zone_____ State_____

SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .



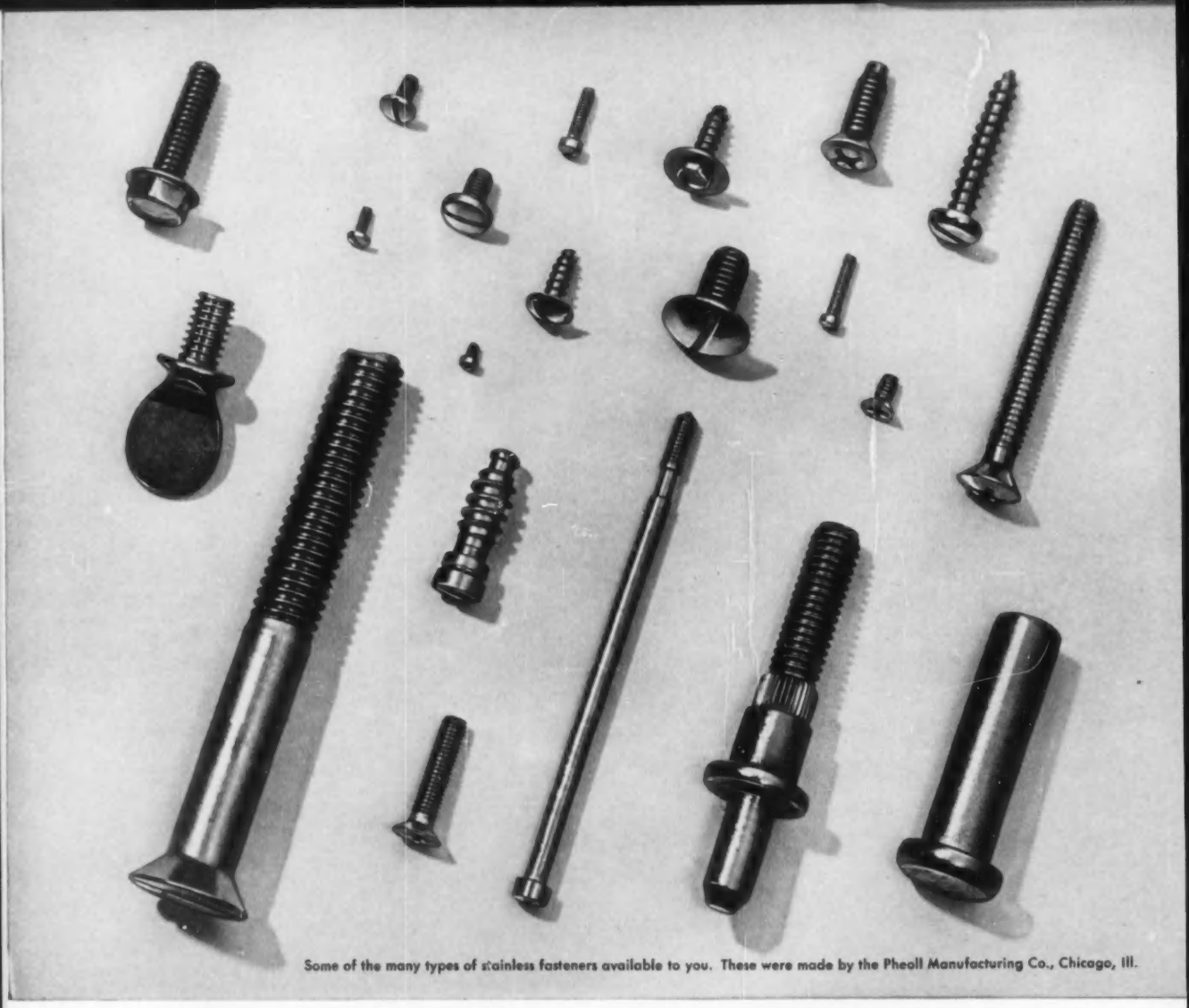
Program Controller . . .

can direct a sequence of operations in a group of machines, or successive steps in a single unit. A shaft-mounted gear motor establishes a tool position, the setting of a variable drive or valve, or the location of a table or indexing device. Built-in "anticipation" adjustment provides a slow-down as settings are approached, avoiding overtravel or hunting. The control is designed to handle actuating equipment rated from sub-fractional to 10 hp. Reset accuracy of 0.2% of full scale is claimed. Most components available from stock. Basic controls under $200; shaft-mounted gear motor about $100 to $200, depending on model. **Jordan Co., Inc., 3235 West Hampton Ave., Milwaukee 9, Wis.**



Quick-access Fastener . . .

for load-carrying panels withstands a shear load capacity of about 7000 lb and a tensile load capacity of 4000 lb in the No. 1 size, locks positively in less than one-half torque-free turn, and compensates automatically for sheet separation resulting from warpage or deformation. Withstands operating temperatures as high as 500 F. Major components of the set are a stud assembly, a retainer and a receptacle. The stud assembly is available in a flush and a protruding-head type. Available from stock in a ¼-in. dia stud size in four lengths to accommodate total sheet thickness ranging from 0.116 to 0.499 in. Approximately 68 to 90¢ per set, depending on order quantity. **Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City, N. Y.**



Some of the many types of stainless fasteners available to you. These were made by the Pheoll Manufacturing Co., Chicago, Ill.

How stainless steel fasteners make a better product at lower cost

Performance and appearance get a boost when you use stainless steel fasteners. For stainless resists rust, heat and corrosion. It keeps its good looks for a lifetime. Stainless-fastened products won't be marred by unsightly rust streaks—and they can be dis-assembled and assembled quickly and easily even after years of all-weather service.

Stainless helps keep production costs down. Work goes smoothly, for fastener heads of high-strength stainless are less apt to burr or nick. And there's no plating on stainless for a careless tool to chip or scrape away.

You cut tooling costs, too. For now stainless fasteners are promptly available in just about *any* size or description—and in any of the 200, 300, or 400 Rezistal stainless series. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

PRODUCTION MEN: If you use stainless steel cold heading wire, Crucible can fill your needs quickly and dependably. It is regularly supplied in all diameters and standard grades, and in a variety of finishes. For more information write for your free copy of the 32-page booklet, "Rezistal Stainless Steel Wire."

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor—Railway & Power Engineering Corp., Ltd.

NEW LITERATURE

The Next Hundred Years

HARRISON BROWN, JAMES BONNER, JOHN WEIR, *California Institute of Technology. Published by Viking Press, Inc., 625 Madison Ave., New York 22, N.Y. 193 pps, 6x9¼ in.* $3.95.

Our earth's future in relation to man and his technology is the main subject of these authors, although earlier chapters picture natural resources and their availability. Based on a series of discussions with executives of 30 major corporations, the book's objective is to provide planning data for corporations. The very sensible premise is that a company lives much longer than a man, hence must plan accordingly.

If anything, the book is conservative in showing how our world can support easily three times our present population—even though food per person has been steadily declining for some years. Among interesting points are: We eat twice as much per capita as East Indians, produce five times as much, use over 100 times as much fertilizer. Japan uses its tillable ground far more efficiently than we. A big population cannot afford to produce protein by feeding animals, so must sacrifice meat for vegetable sources of this dietary factor. A technological shortage is inevitable in the next several decades.

Here is an eminently readable distillation of the somewhat confusing statistics that suggest our future. And much of it deals with the engineer and his future. EJT

Guide to Numerical Production Control

Abstracted from The Production Man's Guide to Numerical Control, by William M. Stocker, Jr., Associate Editor, American Machinist, July 15, 1957. Reprint $0.50.

This technique of controlling manufacturing applies electromechanically expressed numerical values to such elements as feed, speed, length, width, flow, temperature and pressure. At present, numerical control is best applied to short-run jobs that would require extensive tooling and setup if produced on standard automatic equipment. Plating, welding, riveting, assembly, presswork are among the nonmachining applications.

Both machine-tool manufacturers and producers of electrical and electronic control systems are developing, and many have already introduced, successful production equipment. Determining applicability of any tool-and-control system to a particular part or product requires thorough study of the equipment, consultation with suppliers, and experimental runs. At present, numerical control is most effective at such contour-machining jobs as profiling and milling. Such equipment, numerically controlled, has generally paid for itself in a relatively short time.

Conversions of existing equipment and application of control systems to new production machinery represents an annual market potential of over $100 million.

Training is not a serious problem, comparatively, because operation of numerical-control units is generally less complicated than the tools to which they are applied. This will be simplified by standardization programs already under study.

Engineers' Income and Salary Survey, 1956

Published by National Society of Professional Engineers, 2029 K St. NW., Washington 6, D. C., 6x9 in., 45 pp., $1.00.

Third in a series started by the National Society in 1952, the survey is based on an analysis of 17,000 questionnaires returned from engineers in all the technical branches. It shows an increase of 21% in the median earnings of engineers during 1952-56. The median salary and income figure for the engineers responding in 1956 was $9,490, compared with $7,850 in 1952.

Chemical engineers had a median earning total of $11,000 for 1956. Civil engineers had the lowest median earnings of any of the major branches, with a figure of $8,750. Other medians for 1956 were: electrical, $9,460; mechanical, $9,780; mining and metallurgical, $10,000.

A statistical breakdown on over-all earnings of engineers in 1956 shows that 90% of those replying to the questionnaire earned at least $6,390, compared with $5,570 for 90% in 1954. The 1956 survey also shows that 10% of those replying earned at least $19,860. In between these two groups, the 1956 survey shows 75% of the respondents earning at least $7,510; 50% earning at least $9,490; and 25% earning at least $12,840.

All respondents are NSPE members.

Product Development Service—Brochure, 20 pp. Under the headings "Product Planning and Design," "Materials," "Production" and "Processes," this brochure, available to those requesting it on company letterhead, lists specific areas in which this laboratory is staffed and equipped to perform research and development. Franklin Institute Laboratories, 20th and Parkway, Philadelphia 3, Pa.

Guide to Atomic Energy Literature—Booklet, 74 pp. Describes publications and services offered by AEC, and tells how and where to obtain them. Methods for locating and using particular material on various subjects are also described. Atomic Energy Commission, Technical Information Service Extension, P.O. Box 1001, Oak Ridge, Tenn.

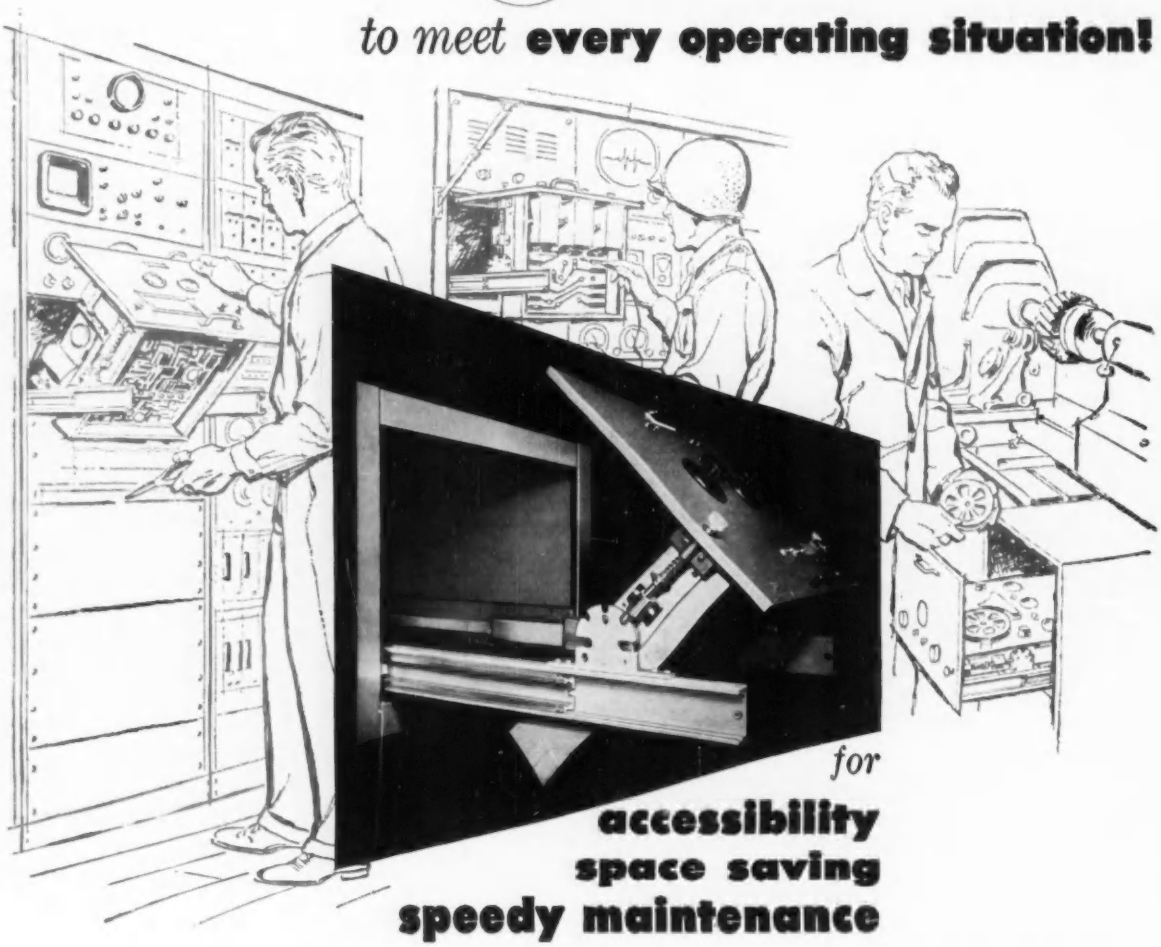
Bibliography on Digital Computers—Booklet, 47 pp. Listed are books and articles that discuss the design and operation of digital computers and their application to business, engineering and scientific problems. Periodicals regularly publishing material on computers are listed in a separate section, as well as a guide to other bibliographies on this same subject. An index is also included in this booklet available without charge. Remington-Rand Div., Sperry-Rand Corp., 315 Fourth Ave., New York 10, N. Y.

Steel Wire—Catalog, 72 pp. Describes production of rod and wire products and services available. Gives complete ordering specifications. Includes diagrams and descriptions of various types and grades of wire, with special emphasis on testing and quality control. Contains a glossary of terms connected with wire and wire manufacture. Colorado Fuel & Iron Corp., 575 Madison Ave., New York, N. Y.

Wire Cloth, Screens, and Products—Catalog, 94 pp. Describes types and sizes of industrial wire cloth available, typical applications, and a number of useful metallurgical tables. A new section gives standard trade definitions and ordering information. Cambridge Wire Cloth Co., Cambridge, Md.

over **100** *designs of* **Grant INDUSTRIAL SLIDES**

to meet **every operating situation!**



for

accessibility
space saving
speedy maintenance

Grant Industrial Slides afford substantial, practical mountings for nearly all types of assemblies—electronic, hydraulic, pneumatic, mechanical. They allow quick access... the pivoting types permit testing or work on underside as well as top of chassis... also provide for quick release of chassis for bench servicing. Slide mounting usually eliminates need for rear access doors and rear aisles—a very important saving of space. Grant slides are soundly engineered, durable and dependable. Load capacities range up to 500 lbs. and more.

Grant engineers and representatives in all important industrial areas offer specialized experience—will aid in working out custom variations to adapt standard slides to especially exacting requirements.

Ask For This Important Working Data

The Grant Industrial Slide Catalogue is a working manual on built-in accessibility. Ask us to mail your free copy.

Grant INDUSTRIAL SLIDES

Grant Pulley and Hardware Corporation
47 High Street, West Nyack, N. Y.
944 Long Beach Avenue, Los Angeles 21, Calif.

SEPT.

9-13 **3rd Annual Titanium Lecture Program,** New York University, College of Engineering. Attendance is limited. For further information contact Dr. Harold Margolin, New York University, University Heights, 53, N. Y.

9-13 **12th Annual Instrument & Automation Conference,** Cleveland Public Auditorium, Cleveland, Ohio. Sponsored by the Instrument Society of America.

17-18 **Technical Symposium on Numerical Control Systems for Machine Tools,** Sponsored by the Engineering Department of the Electronic Industries Association (formerly RETMA). Purpose of the conference is to disseminate technical information on operation of electronically-controlled machine tools. The program has been designed to span the information requirements of the machine tool manufacturer; manufacturer of associated controls; manufacturing, planning, and tooling groups in aircraft companies; and prospective users of electronically-controlled machine tools in other industries.

23-25 **American Society of Mechanical Engineers, Fall Meeting** at the Statler Hotel, Hartford, Conn. Papers cover hydraulics, gas turbine power, safety in machine design, engineering management, metals engineering, lubrication, and engineering education.

24-25 **6th Annual Industrial Electronics Symposium,** Morrison Hotel, Chicago, Ill. Major subjects will be: Development of Transducers, and Other Elements of Industrial Electronics Systems, and Integrated Systems for Industrial Electronic Control.

OCT.

7-9 **National Electronics Conference** at the Hotel Sherman, Chicago, Ill. Technical sessions cover varied aspects of electronics including servomechanism applications, semiconductor devices, microwaves, radio astronomy, computers, instrumentation, and circuit theory.

7-7 **ASME-ASLE Joint Conference on Lubrication** at the Royal York Hotel, Toronto, Canada.

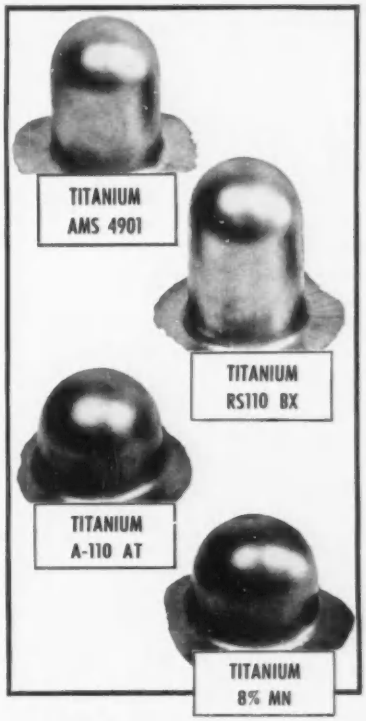
7-11 **American Institute of Electrical Engineers, Fall General Meeting** at the Hotel Morrison, Chicago, Ill. Program will include 50 sessions by the Institutes six technical divisions—Communications, General Applications, Industry, Instrumentation, Power and Science, and Electronics. Subject matter will span nuclear reactors, telegraph systems, research, ethics, television and aural broadcasting, basic science, safety, computing devices and the chemical industry.

9-11 **Society for Experimental Stress Analysis Annual Meeting** at Hotel El Cortez, San Diego, California. Complete details may be obtained from Dr. W. M. Murray, Secretary-Treasurer, Post Office Box 168, Cambridge 39, Mass.

10-11 **National Noise Abatement Symposium,** Hotel Sherman, Chicago, Ill.

13-17 **Pressed Metal Institute, Annual Meeting,** Castle Harbor Hotel, Bermuda.

14-18 **International Industrial Development Conference,** Fairmont Hotel, San Francisco, Calif. Conference is concerned with how private industry with cooperation of government can increase the rate of industrial development and economic growth in the free world.



Titanium Cylinders drawn in one stroke on the same die

Titanium, magnesium, zirconium, stainless and aluminum 2024 are deep drawn in one operation by Brooks & Perkins.

Cost of staging dies and intermediate anneals is eliminated.

. . . Whenever you are faced with a difficult or delicate operation-problem in Magnesium or Titanium, a talk with B&P engineers is well worth while.

Engineering Facilities in Detroit and Los Angeles

. . . Write for Titanium and Magnesium engineering data — also folder on B&P's facilities to handle tough jobs.

BROOKS & PERKINS, Inc.

Magnesium-Titanium Fabrication
Magnesium and Boral Sheet and Plate

1956 West Fort St.
Detroit 16, Mich.
Phone: TAshmoo 5-5900
IN LOS ANGELES:
11655 Vanowen St.
North Hollywood, Cal.
Phone: STanley 7-9665

56-C

OFFICES IN NEW YORK, WASHINGTON, DALLAS

Take any One of these three books FREE

with your first selection and charter membership in the McGraw-Hill

Mechanical Engineers' Book Club

COMPRESSED AIR HANDBOOK		
or	*Publisher's Price:*	**$8.00**
METALS PROPERTIES		
or	*Publisher's Price:*	**$11.00**
TOOL ENGINEERS HANDBOOK		
	Publisher's Price:	**$15.00**

Please accept any one of these three books AS A GIFT—with your first selection chosen from the books listed in the coupon.

We invite you to look over these fourteen books in the coupon. They are important technical books indispensable to a field so dynamic that even the well-informed can hardly keep up. And they suggest the quality of the volumes that will be made available to you as a Club member.

Membership in the New McGraw-Hill Mechanical Engineers' Book Club is *easy* and *economical*. The Club will bring to your attention outstanding books in your field that you might otherwise miss. Possibly just one idea from one of these books could mean more to you in actual dollars and cents than many times the cost of the book. And you may obtain any or all selections at substantial savings.

How the Club operates. The Club will describe all forthcoming selections to you. Every second month you will receive free of charge *The Mechanical Engineers' Book Club Bulletin*. This gives complete advance notice of the next main selection as well as a number of alternate selections. All books are chosen by editors of the McGraw-Hill Book Company whose thoroughgoing understanding of the standards and values of technical literature will be your guarantee of the authoritativeness of the selections.

From this point on, the choice is yours. If you want the main selection you do nothing; the book will be mailed to you. If you want an alternate selection or if you want no book at all for that two-month period, you notify the Club by returning the form and postage-paid envelope which is always enclosed with your *Bulletin*.

We ask you to agree only to the purchase of three books a year. Certainly out of the large number of books in your field offered you in any twelve months there will be at least three *you would buy in any case*. By joining the Club you will save, in cost, about 15 per cent from the publishers' prices.

Reach for your pen right now and fill out the coupon. You need send no money now. By taking advantage of this special introductory offer you will receive absolutely FREE a copy of the *Compressed Air Handbook*, or *Metals Properties*, or the *Tool Engineers Handbook*, together with your first selection—at the special club price.
So mail the coupon *today!*

Mail to: The McGraw-Hill Mechanical Engineers' Book Club
330 West 42nd Street, New York 36, N. Y. P. O. Box 97

Please enroll me as a member of the Mechanical Engineers' Book Club. I am to receive FREE the book I have indicated along with my first selection checked below. You will bill me for my first selection only at the special club price, plus a few additional cents for postage and handling. (The Club assumes this charge on prepaid orders.)

Forthcoming selections will be described to me in advance and I may decline any book. I need take only 3 selections or alternates in 12 months of membership.

☐ **Compressed Air Handbook,** 2nd Ed., by the Compressed Air and Gas Institute. Publisher's Price, $8.00. Club Price, $6.80.

☐ **Metals Properties** sponsored by the ASME. Publisher's Price, $11.00. Club Price, $9.35.

☐ **Tool Engineers Handbook** sponsored by the ASTE. Publisher's Price, $15.00. Club Price, $12.75.

☐ **Mechanism** by Joseph S. Beggs. Publisher's Price, $7.50. Club Price, $6.40.

☐ **Piping Handbook,** 4th Ed. by Sabin Crocker. Publisher's Price, $12.00. Club Price, $10.25.

☐ **Structure of Metals,** 2nd Ed., by Charles Barrett. Publisher's Price, $11.00. Club Price, $9.35.

☐ **Water Conditioning for Industry** by Sheppard Powell. Publisher's Price, $10.00. Club Price, $8.50.

☐ **Dynamics of Machinery** by James Hartman. Publisher's Price, $7.50. Club Price, $6.40.

☐ **Principles of Metal Casting** by Richard W. Heine and Phillip C. Rosenthal. Publisher's Price, $7.50. Club Price, $6.40.

☐ **Contracts, Specifications and Engineering Relations,** 3d Ed., by Daniel Mead. Publisher's Price, $7.00. Club Price, $5.95.

☐ **Fundamentals of Vibration Analysis** by N. O. Myklestad. Publisher's Price, $6.50. Club Price, $5.50.

☐ **Control of Nuclear Reactors and Power Plants** by M. A. Schultz. Publisher's Price, $7.50. Club Price, $6.40.

☐ **Problems and Control of Air-Pollution** edited by Frederick S. Mallette. Publisher's Price, $7.50. Club Price, $6.40.

☐ **Modern Physics for the Engineer** edited by Louis Ridenour. Publisher's Price, $8.00. Club Price, $6.80.

No-risk guarantee. If not completely satisfied, I may return my first shipment within 10 days and my membership will be canceled.

Name .....(Please Print)

Address .....

City .....Zone.....State.....

PE 9-57

This offer is available only in the United States and its possessions. In Canada write McGraw-Hill Canada, 253 Spadina Road, Toronto 4.

INDEX TO ADVERTISERS

This index is published as a convenience to the readers. Every care is taken to make it accurate but PRODUCT ENGINEERING assumes no responsibility for errors or omissions.

AMP, Inc. 30
Ajax Flexible Coupling Co. 56
Allegheny Ludlum Steel Co. 17
Aluminum Goods Mfg. Co. 26-27
American Viscose Corp. 50
Armstrong Cork Co. 12
Atlas Chain & Mfg. Co. 39

Brooks & Perkins, Inc. 69

Central Foundry Div., General Motors Corp. 20-21
Chrysler Corp., Industrial Engine Div. 57
Crucible Steel Co. of America 66

du Pont de Nemours & Co. (Inc.), E. I., Elastomers Div. 44-45
du Pont de Nemours & Co. (Inc.), E. I., Polychemicals Dept. 18

Electric Steel Foundry Co. 60
Electro Metallurgical Co., Div., Union Carbide Corp. ..... 3rd Cover
Enjay Co., Inc. 24

Falcon Machine & Tool Co., Inc. 72
Fluidwick Co. 32

Goodyear Tire & Rubber Co. 3
Grace & Co., W. R., Polymer Chemicals Div. 7
Grant Pulley & Hardware Corp. 68

Haydon Co., A. W. 34

Link-Belt Co. 10

McGraw-Hill Book Co., Inc. 70
Mallory-Sharon Titanium Corp. 14
Minnesota Mining & Mfg. Co. 48

New Jersey Zinc Co. 22

Parker-Hartford Corp. 71
Porcelain Enamel Institute, Inc. 35-38
Potter & Brumfield, Inc., Subs. of American Machine & Foundry Co. 64-65

Shakeproof Div., Illinois Tool Works ..... 2nd Cover

Thiokol Chemical Corp. 9
Torngren Co., C. W. 72
Torrington Co. 4
Turco Products, Inc. 63

U. S. Graphite Co., Div. of the Wickes Co. ..... 4th Cover
U. S. Rubber Co., Footwear Div. 62
U. S. Rubber Co., Mechanical Goods Div. 55

PRODUCT ENGINEERING ADVERTISING SALES STAFF

Atlanta 3 . . . M. H. Miller, 1301 Rhodes-Haverty Bldg., Jackson 3-6951

Boston 16 . . . M. A. Williamson, Jr., 350 Park Square Bldg., Hubbard 2-7160

Chicago 11 . . . A. E. Meanor, R. W. Bruley, 520 N. Michigan Ave., Mohawk 4-5800

Cleveland 15 . . . A. F. Tischer, 1510 Hanna Bldg., Superior 1-7000

Dallas 1 . . . E. E. Schirmer, 901 Vaughn Bldg., 1712 Commerce St., Riverside 7-5117

Denver 2 . . . John W. Patten, 1740 Broadway, Mile High Center, Alpine 5-2981

Detroit 26 . . . P. B. Robinson, 856 Penobscot Bldg., Woodward 2-1793

Los Angeles 17 . . . H. L. Keeler, 1125 West Sixth St., Madison 6-9351

New York 36 . . . P. G. Weatherby, B. K. Adams, 500 Fifth Ave., Oxford 5-5959

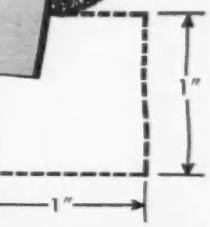
Philadelphia 3 . . . D. G. Jones, Architects' Bldg., 17th & Sansom Sts., Rittenhouse 6-0670

Pittsburgh 22 . . . C. E. Leveroni, 1111 Oliver Bldg., Atlantic 1-4705

St. Louis 8 . . . A. E. Meanor, 3615 Olive St., Continental Bldg., Jefferson 5-4867

San Francisco 4 . . . W. C. Woolston, 68 Post St., Douglas 2-4600

HOW TO CONTROL MORE THAN 7,000 functions IN THIS CONFINED AREA with 3 dimensional CAMS



Yes, in less than one square inch, about the area of an ordinary postage stamp, the output of the Parker 3 D cam can be expressed as a dependent variable . . . the resultant of two known independent variables which can produce precision functions in split seconds!

$$z = f(xy)$$

where z is the output of the 3 D cam; x and y are the two known variables.

These functions transferred through a follower assembly can activate:

AIRCRAFT—Jet Fuel Injection, Missile Control, Navigational Control, etc.

MACHINE TOOL—Automation Functions Repetitive Production, Feed Back Functions, etc.

COMMERCIAL—Pre-computed Functions Stored Information, Mental-Mechanical Functions, etc.

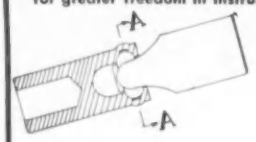
Send today for FACT FILLED brochure—"3 Dimensional Cams." See how Science SAVES SPACE, produces MECHANICAL SOLUTIONS IN SECONDS!

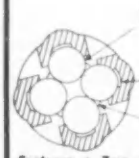
THE PARKER-HARTFORD CORPORATION
CAM DIVISION
FRANKLIN AVENUE • HARTFORD, CONNECTICUT

MINI-JOINTS*

***Miniature Universal Joints with ZERO BACKLASH**

for greater freedom in instrument design





Features • Zero backlash • Maximum operating angle of 30° • Lightweight • Sealed-in Lubrication

DIMENSIONS

Part NO.	ID	OD	OL	WGT.
SBS	SOLID	3/16	1-1/32	
1BS	.0938	"	"	.005
2BS	.125	"	"	"
3BS	.156	9/32	1-3/8	.013#
4BS	.1875	"	"	"
5BS	.2188	3/8	1-3/4	.031#
6BS	.250	"	"	"

(Also available as double joints)

Send for further information . . . available promptly on request.

FALCON MACHINE & TOOL CO., INC.

209 CONCORD TURNPIKE, CAMBRIDGE 40, MASS.

NOW get Torngren's DESIGNERS' GUIDE to Metal Spinning!

Complete with charts, diagrams and illustrations, C. W. Torngren's folder on its exclusive MECATORN process gives you a concise discussion on metal spinning and its value to you in cutting costs.

TOPICS DISCUSSED INCLUDE:

- comparison of spinning and pressing a typical part
- MECATORN spinning capacities
- how spinning is done
- spinnability of various metals
- shapes suited to spinning
- advantages of spinning
- dimensional tolerances
- tooling required
- heat treating
- welding and fabrication

C. W. TORNGREN

COMPANY, INCORPORATED

236 Pearl St., Somerville, Mass.

Please send me your Designers' Guide

Name_____

Firm_____

Address_____

City_____ State_____

Publisher's Postscript...

Why special advertising for engineers?

An executive of a large advertising agency recently said to me, "I don't see why engineers are any different than other people in their buying habits—they are people—and I don't see why they shouldn't be influenced by the same sales appeals we use in our consumer advertising. Why should we prepare special advertising copy for them? Our product advertising is most successful, and it should work as well in a technical paper like *Product Engineering* as it does in general or business news magazines like *Time, Business Week* or *Newsweek*."

My reply went something like this: "Consumer advertising would work as well in a technical publication for a product the engineer bought for his personal use. He is largely influenced by the same appeals—the same personal benefits—as is the average consumer. Maybe he is a bit more analytical—but on the whole the engineer enjoys the same pleasures, has the same emotional reactions, sees the same shows, drives the same automobiles, smokes the same cigarettes or tobacco as other folks. If he buys a new or unknown brand for his personal use, it is strictly his business. His decision is his own and he alone has to live with it.

"But when this same engineer has to decide on a type or make of product to be used in his plant or product, he buys *professionally*. He wants all the facts, not only of one brand, but of all its recognized competitors as well. He wants performance data. He wants to be sure the manufacturer or supplier has the know-how, plus the facilities to back up his claims.

"The principal asset of the engineer is his standing in his field, his abilities, his reputation, the efficiency of his department. He can't afford to gamble—there's too much at stake. The consumer buys a product—usually one or a few for his own purposes—the engineer may specify for thousands or millions."

All of which reflects the importance of facts and useful information in advertising directed toward engineers. The advertising pages of an engineering magazine can be just as informative or helpful as the editorial content. And many advertisers recognize this important fact.

The publisher can't control the content of his advertiser's sales messages, but you must admit more and more advertising pages have in them the kind of information you need and want. We, on *Product Engineering*, are spending a lot of money to influence advertisers to put the kind of information you need into their ads. We want to make every advertising page useful to you and worth your reading time because the more you know about all the materials, parts, components and product finishes the less time you spend searching out information.

We are trying to improve the usefulness of the advertising pages to you just as we are constantly working to improve editorial content and methods of presentation. Your frank expressions on either editorial or advertising are always welcome. This is your magazine. —A. H.

F.Y.I. (personal)

Now they'll write on grease

That's the claim Parker Pen Co. makes for its new T-Ball Jotter pens. The secret: a porous, sintered tungsten carbide ball that has a "textured" surface which "grips the writing paper as a tire tread grips the road" and "assures non-skip, non-slip writing." Parker is using the T-Ball in two new pens now (retailing at $1.95 and $2.95), but plans to make the sintered ball available later on in standard refills that will fit older models.

Want your own solar furnace?

If you'd like to harness the work rays of the sun (see page 80), you can now do it—for just two dollars. Abercrombie & Fitch is marketing a "solar cigarette lighter"—a 4½-in. polished, shaped aluminum disk with a coiled wire mounted in the center to hold the cigarette and keep fingers from getting burned. Simple but effective (if the sun is shining)—and a bright idea for a new product.

"Everything" for the fisherman

A triple-threat product that combines scale and scaler with a fish knife is the latest offering for the fisherman's tool kit. The knife becomes a balance scale when opened and hung from a thong attached at its center. The fish is hooked to weight indicating points marked on the back of the blade. Markings run from 10 oz. to 10 lb. Back edge of the blade is serrated to scrape off the fish's own scales. Over-all length of the knife is just under six in. Price: $4.95 (postpaid) from Hoffritz for Cutlery, 331 Madison Ave., New York 17.

This camera rides a binocular

A new binocular-camera mounts a 20-exposure 16mm photographic unit and telephoto lens on a 7x35mm prism binocular. Individually focused eyepieces act as range-finders for setting the camera lens so the user can take pictures of distant objects—and take exactly the scene that is viewed. Shutter speeds are 1/30 to 1/800 sec.; and the unit has an f3.5, 90mm lens. Cam-Binox is made by Moller Optical Works, Hamburg, Germany; sold by Abercrombie & Fitch, New York, and Von Lengerke & Antoine, Chicago. Price: $400. Incidentally, it's a good example of combining two separate products to make a new one.

FIRST CLASS
PERMIT NO. 64
(SEC. 34.9, P.L.&R.)
NEW YORK, N. Y.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

4c—POSTAGE WILL BE PAID BY—
McGRAW-HILL PUBLISHING CO., Inc.

PRODUCT ENGINEERING
330 WEST 42nd STREET
NEW YORK 36, N. Y.

One year brings you this:
26 issues of R & D edition; 26 issues of Design edition;
***plus* annual Design Digest Issue in October**
All for only $5

FIRST CLASS
PERMIT NO. 64
(SEC. 34.9, P.L.&R.)
NEW YORK, N. Y.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

4c—POSTAGE WILL BE PAID BY—
McGRAW-HILL PUBLISHING CO., Inc.

PRODUCT ENGINEERING
330 WEST 42nd STREET
NEW YORK 36, N. Y.

WHY DON'T THEY RESEARCH & DEVELOP

. . . an amateur's movie camera in which ordinary film is replaced by magnetic tape. Then the camera could double as a playback mechanism for driving home television receivers on a closed circuit. Current advances in TV recording make the substitution perfectly feasible. Here's what you'd gain: a film that's easily spliced and reusable, doesn't need developing or a projection screen.

. . . a light switch for houses and offices that operates at the wave of a hand. A simple light-, heat-, or proximity-sensitive relay would close and open a mercury switch (for silent operation. Unit shoud fit in the standard wall space, take its power from the 115v lines, have a simple, unobtrusive appearance. Same idea could work with table lamps, radios, appliances. Price: under $5, preferably under $3.

. . . a watch no larger than a quarter which, when activated by touch, lights up to show the time—either in numerals or with a standard clock face. The disk would have to be a simple radio receiver (operating on free electromagnetic power) that will respond to a transmitted signal. Maximum dimensions: 1 in. dia, 1/16 in. thick. Cost: under $100.

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and identify the originator of) similar ideas based on known scientific principles but lacking an inspired manufacturer.

OK . . . enter my subscription to the new weekly PRODUCT ENGINEERING for one year . . . which will bring me 26 Design editions and 26 R & D editions, plus the new Design Digest Issue as part of service when it appears in October 1957.

☐ Bill Me ☐ Bill Company ☐ Payment Enclosed

NAME . . . . . TITLE . . . . .

ADDRESS ☐ Home ☐ Business . . . . .

CITY . . . . . ZONE . . . STATE . . . . .

COMPANY . . . . . M.

PRODUCT MFGD. OR DESIGNED . . . . . D—

☐ Please send . . . . . additional order cards to give to friends

9-9-57

Fill in and mail one card today for your own personal subscription. Pass other card along to a friend

OK . . . enter my subscription to the new weekly PRODUCT ENGINEERING for one year . . . which will bring me 26 Design editions and 26 R & D editions, plus the new Design Digest Issue as part of service when it appears in October 1957.

☐ Bill Me ☐ Bill Company ☐ Payment Enclosed

NAME . . . . . TITLE . . . . .

ADDRESS ☐ Home ☐ Business . . . . .

CITY . . . . . ZONE . . . STATE . . . . .

COMPANY . . . . . M.

PRODUCT MFGD. OR DESIGNED . . . . . D—

☐ Please send . . . . . additional order cards to give to friends.

9-9-57

STAINLESS STEEL MAKES THE DIFFERENCE

...its effect on the sale of new designs

Designers gain prominence through the effectiveness and saleability of their work. The sales appeal of stainless steel is a powerful tool for selling new designs. It has turned many design ideas into profitable products.

The recognized merits of stainless steel, such as strength and corrosion resistance, make it equally "right" for housewares, jet engine parts, or chemical equipment. These qualities plus a variety of finishes have put stainless into planes, trains, cars, cafeterias, and scores of other places.

For more facts about stainless steel see your supplier. For a free copy of "Stainless Steel in Product Design" write: ELECTRO METALLURGICAL COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

This 40-page book will give you important facts about selecting and applying stainless steel. Write for it today.

METALS DO MORE ALL THE TIME ...THANKS TO ALLOYS

Electromet
FERRO-ALLOYS AND METALS

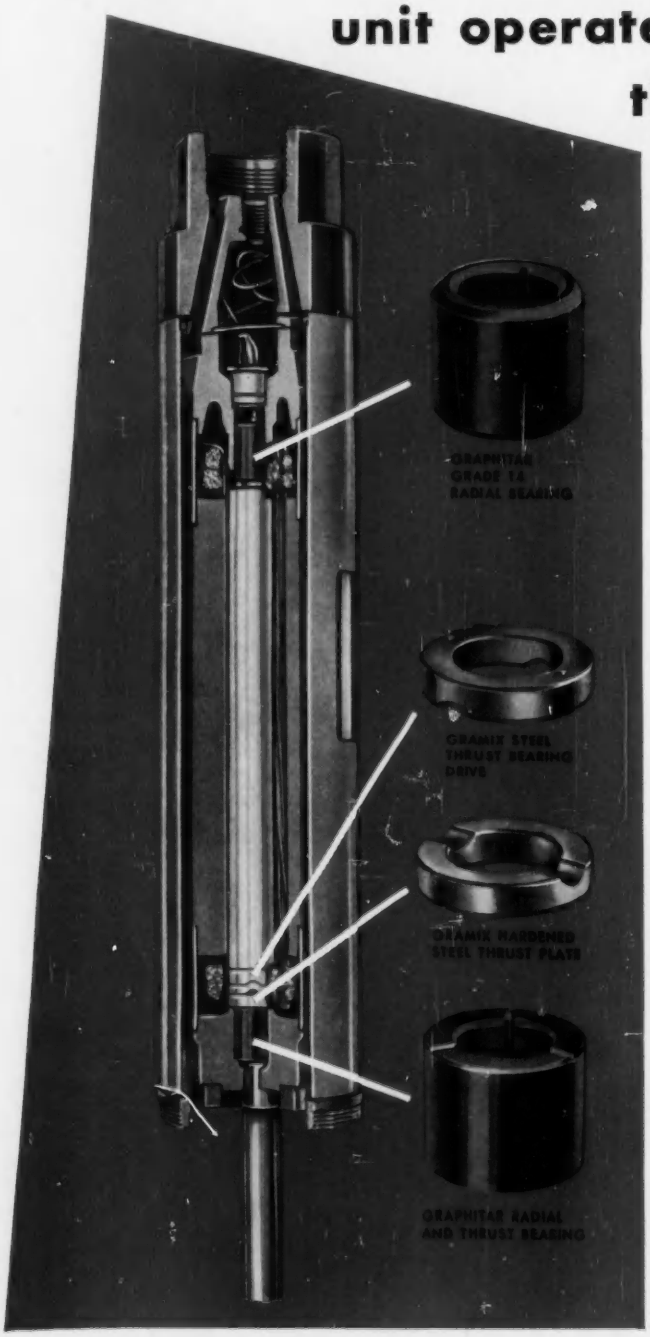
UNION CARBIDE

The terms "Electromet" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

GRAPHITAR® and GRAMIX®

(CARBON-GRAPHITE) (PRODUCTS OF POWDER METALLURGY)

bearings in Leland submersible motor unit operate with gasoline as the only lubricant


GRAPHITAR GRADE 1A RADIAL BEARING
GRAMIX STEEL THRUST BEARING DRIVE
GRAMIX HARDENED STEEL THRUST PLATE
GRAPHITAR RADIAL AND THRUST BEARING

Running directly in gasoline, this superbly-designed Leland submersible motor embodies two GRAMIX thrust washers and two GRAPHITAR bearings to keep the operation of this amazing explosion-proof pump motor safe and smooth.

Thirty years ago the manufacturer of these pumps—the Leland Electric Co., Dayton, Ohio, a division of American Machine and Foundry Co., developed the first gasoline curb-pump motor to receive Underwriters' Laboratories' approval. Throughout their long experience, they have selected every component with great care. It is thus significant that for Leland's submersible motor they selected GRAPHITAR and GRAMIX bearings.

GRAPHITAR is a non-metallic, carbon-graphite material that will not weld or score even when in contact with a metal shaft. Any liquid will act as a lubricant, thereby reducing friction and increasing service life. With low-viscosity liquids such as gasoline, friction is at a minimum because of the low film strength.

GRAMIX, tough, long-wearing sintered-metal, has an extremely high particle hardness and excellent surface finish; can be precision die-pressed to tolerances within .0005". GRAMIX parts can withstand incredible amounts of pounding action. These factors, coupled with their extremely low cost, have helped add to the increasing use of GRAMIX parts in many industries.

Write today for these two new engineering bulletins GRAPHITAR Bulletin No. 20, and GRAMIX Bulletin No. 21.

238

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 1, MICHIGAN

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® SINTERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES